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MAR 21 1947

Electrical Construction and Maintenance

With which is consolidated ELECTRICAL CONTRACTING

MARCH · 1947

A McGRAW-HILL PUBLICATION

G-E *FLUORESCENT* BALLASTS

can help you win favor for your fixtures

One good way to start and wind up a sales story on fluorescent fixtures is to say, " . . . *the ballasts are G-E.*"

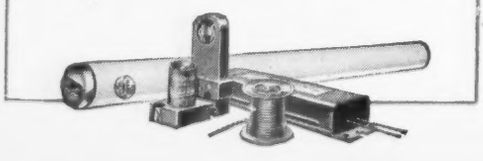
There's a reason for people's confidence in that name. With fluorescent lamp ballasts, it's the everlastingly watchful testing of raw materials and control of manufacturing processes which G-E maintains.

More than 20 tests assure the uniform quality of all ballast components. Completed ballasts are tested continually for voltage, heating and lighting characteristics. Finally, production line samples are subjected to *independent* tests by the Electrical Testing Laboratories*.

Silent salesman

We realize you are not getting all the G-E ballasts you need as quickly as you want them, but please remember that we are doing our utmost to increase production, despite continuing material shortages.

BALLASTS LAMPS STARTERS
CABLE LAMPHOLDERS
for
DEPENDABILITY in fluorescent lighting



The quiet operation of G-E ballasts can help a lot to *keep* your fixtures sold. So will the assurance they give of rated light output and freedom from maintenance expense. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

**Also listed by Underwriter's Laboratories, Inc*

GENERAL ELECTRIC

412-3-5205

This is the Murray MAGNETIC CIRCUIT BREAKER

in the RAIN-TIGHT OUTDOOR BOX with the patented hub!

OFFICES IN PRINCIPAL CITIES

THIS enclosure of deep-drawn construction and patented one-piece top, is designed to be weather-proof. Made of corrosion-resistant metal with baked-on aluminum finish. This rain-tight device gives proper protection to the Murray Magnetic Circuit Breakers mounted within it.

Murray Service Equipment is simplicity itself. Removal of but one screw releases the main cover. Note that the overhanging cover over the breakers, as well as the main cover, are sealable.

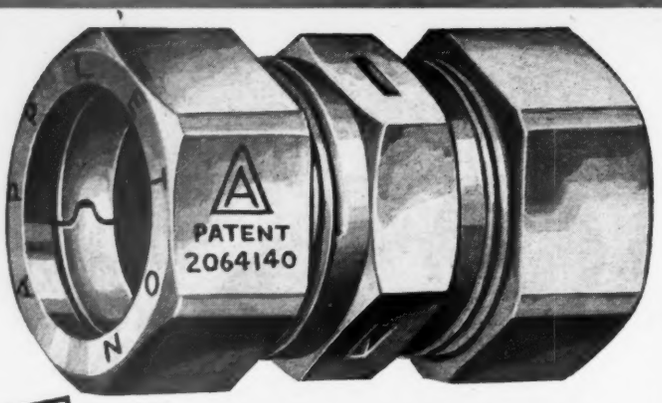
Murray Magnetic Circuit Breakers are made in capacities of 10, 15, 20, 25, 35 and 50 amperes, 125 volts A.C. All are suitable for 125/250-volt 3-wire A.C. service.

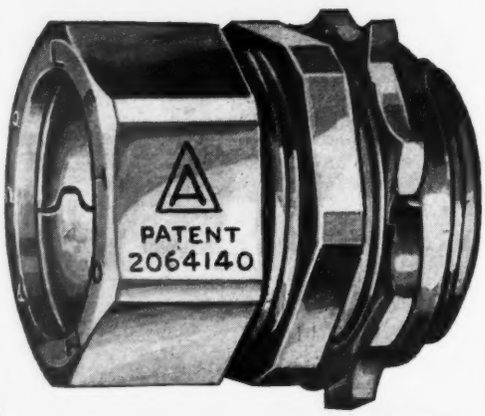
The use of a magnetic tripping mechanism and an efficient magnetic blow-out provides an instantaneous circuit interruption in the event of a short circuit A precision time-delay device accommodates the brief overloads normally encountered, such as motor-starting currents or the high initial current flow through tungsten lamps. The characteristics of the Murray Magnetic Circuit Breaker are not affected by above-normal temperatures ordinarily found in service equipment.

METROPOLITAN DEVICE CORPORATION

BROOKLYN 16, NEW YORK

ALL SIZES UNDERWRITERS' LABORATORIES APPROVED





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File E14815.

November 1, 1946

L6.

Appleton Electric Co.,
1701-29 Wellington Ave., Chicago 13, Ill.

Electrical Metallic Tubing Fittings.

Machined-steel and malleable-iron fittings with split steel clamping ring, for electrical metallic tubing ½ to 2-in. sizes incl. Couplings, Cat. Nos. 95T050*, 95T075*, 95T100*, 95T125*, 95T150*, 95T200*. Connectors, Cat. Nos. 96T050*, 96T075*, 96T100*, 96T125*, 96T150*, 96T200*.

*Indicates suitability for raintight and concretetight applications.
Marking: Listee's name, letter "A" in a triangle, or "Appleton."

Listed—Reexamination Service.

See description of Reexamination Service on guide card.

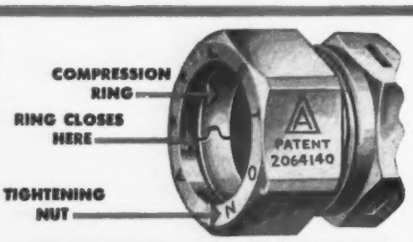
This card replaces E14815 dated June 25, 1946.
This card is issued by Underwriters' Laboratories, Inc.

PRINTED IN U.S.A.

APPLETON COUPLINGS and CONNECTORS

FOR ELECTRICAL METALLIC TUBING

...With Hexagonal Tightening Nuts That FIT the Wrench



APPROVED WATERTIGHT

Appleton Couplings and Connectors are equipped with concave, piston-ring-type split compression ring. Tightening nut closes ring securely to tubing, forming rigid, watertight connection.

SEND TODAY

Big Appleton Catalog, illustrating and describing more than 15,000 types and sizes of wiring equipment, gladly sent FREE, on request, to any user of such material.

Appleton pioneered in the development of precision-made Couplings and Connectors that form a rigid, permanent, approved-watertight connection in electrical metallic tubing.

Appleton Couplings and Connectors meet fully and exactly every requirement of the industry for quick, easy installation and long service. They embody every possible improvement. All sizes are Underwriters' Laboratories Approved. Users everywhere have found it pays to specify them on every fitting order.

All sizes have hexagonal nuts, and hexagonal center sections, which are easily held rigidly with a wrench while tightening. Connectors have high knockout closing shoulders, and are equipped with bonding-type locknuts which fasten securely to outlet boxes, panel boxes, and other equipment.

Like all of the 15,000 fittings in the COMPLETE APPLETON LINE, Appleton Couplings and Connectors are "STANDARD FOR BETTER WIRING!"

Sold Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 50 Church Street • DETROIT 7310 Woodward Avenue • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna Street • ST. LOUIS, 423 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Avenue • ATLANTA, 724 Boulevard, N. E. • BIRMINGHAM, 6 N Twenty-first Street • MINNEAPOLIS, 305 Fifth Street, S • PITTSBURGH, 414 Bessemer Bldg., BALTIMORE, 100 Ea Pleasant Street • BOSTON, 10 High Street • DENVER 1509 Seventeenth Street • PHILADELPHIA, 1017 Cherry Stree

Resident Representatives: Cincinnati, Dallas, Kansas City, Milwaukee New Haven, New Orleans, Seattle.

APPLETON ELECTRIC PRODUCTS REG. U.S. PAT. OFF.

APPLETON

CONDUIT FITTINGS • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

Electrical Construction and Maintenance

With which is consolidated Electrical Contracting, The Electragist and Electrical Record...Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

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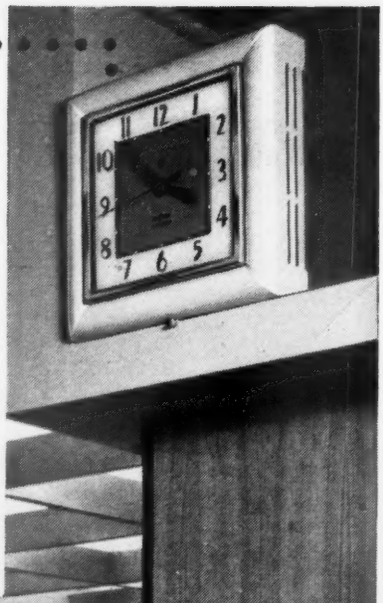
MAR 31 1947

EXCLUSIVE!.....

NuTONE DOOR CHIMES "MERIT SPECIFIED" IN ALL CASE STUDY HOUSES!



●Here's the NUTONE Chime in Case Study House No. 16—one of a series sponsored by the West Coast magazine, *Arts & Architecture.* It's a *combination* NUTONE 2-door Chime and *Telechron* Clock—in a single compact unit that's easy to plan for, easy to install. Nine inches square; white enamel with chromium crystal case. Note the large, easy-to-read dial. Suggestions for wiring this NUTONE Door Chime and Clock and helpful planning material on other NUTONE Chimes are yours for the asking. Write or phone your nearest NUTONE office.

RODNEY A. WALKER, prominent West Coast architect, designed and built Case Study House No. 16, using a time-saving modular system he originated several years ago. Plates are drilled every three feet—each dimension being a multiple of thirty-six inches. Studs are drilled at both ends. Hardwood dowels inserted into the holes permit the framework to be assembled "Tinker-Toy" fashion.

(Above) NUTONE *Door Chime and Clock (list, $14.95) in kitchen of Case Study House No. 16*

CASE STUDY HOUSE NO. 16 is only one of the homes being built for public demonstration in southern California by the magazine, *Arts & Architecture.* Object of the program is to show results of the best thinking both by designers and by manufacturers of the equipment and accessories that complete a modern home. Specification of products, from building materials to door chimes, was based on merit alone.

NUTONE IS THE WORLD'S LARGEST MAKER OF DOOR CHIMES

NUTONE TRADE MARK DOOR CHIMES

...better living means better listening, too!

NUTONE, INCORPORATED, MERCHANDISE MART, CHICAGO 54;
200 FIFTH AVE., NEW YORK 10; 931 EAST 31st ST., LOS ANGELES 11; TERMINAL SALES BLDG., SEATTLE 1

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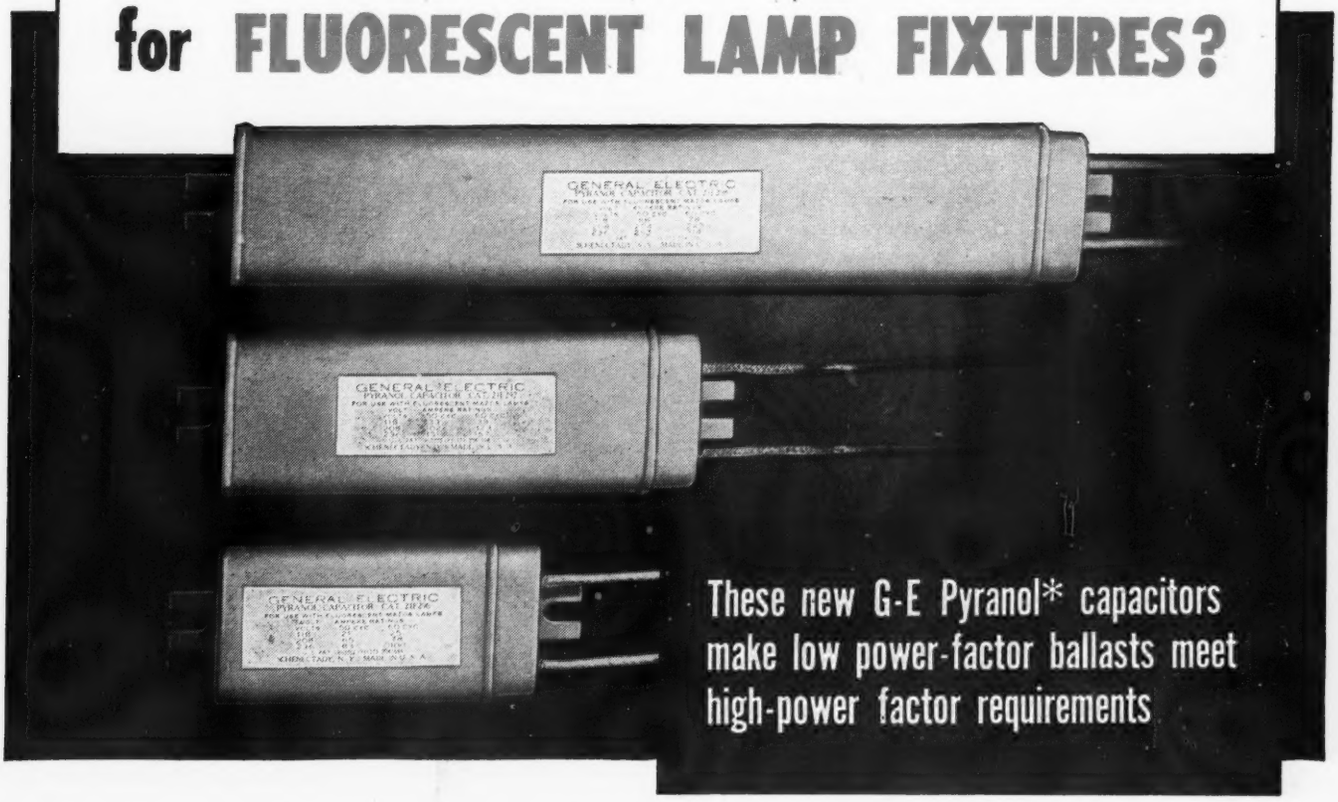
need POWER-FACTOR IMPROVEMENT for FLUORESCENT LAMP FIXTURES?



If your present supply of high-power-factor ballasts is inadequate for your high-power-factor fixture requirements, use the new G-E Type FL capacitors.

These new Type FL capacitors**, when simply installed in the fixture with available ballasts, bring low-power-factor equipment up to acceptable power-factor levels.

The size and weight of these new capacitors permit easy assembly in new or existing fixtures. A short shipping schedule on Type FL capacitors make them available for current fixture business—*now—when you need them.*

These hermetically sealed Pyranol impregnated units, featuring new low cost as well as small, light-weight design, offer the same high quality as millions of G-E capacitors now used in fluorescent installations.

Three designs are available for operation at 50 or 60 cycles, 118, 208 or 236 volts a-c, and when used individually, or in combinations as suggested, provide a minimum of 85 to 95 percent power factor for a single 15-watt lamp, or up to four 40-watt lamps. For further details, write to *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

***Listed by Underwriters' Laboratories, Inc.*

DATA FOR 60 CYCLE, 118 VOLTS A-C

Lamp Size Watts	1 Lamp	Approx. P-F	2 Lamps	Approx. P-F	3 Lamps	Approx. P-F	4 Lamps	Approx. P-F
15-T-8	S	95	M	86	L	95+	L	86
15-T-12	S	86	S & M*	95+	L	88	S & L*	87
20-T-12	S	90	M	85	M & L*	91	L	85
30-T-8	M	85	L	85	M & L*	86	L & L*	86
40-T-12	M	86	L	86	M & L*	86	L & L*	86

Symbols: S—Cat. No. 21F296; M—Cat. No. 21F297; L—Cat. No. 21F298 *Two capacitors in parallel

VOLT-AMPERE RATINGS

Volts A-C	21F296		21F297		21F298	
	50 Cycle	60 Cycle	50 Cycle	60 Cycle	50 Cycle	60 Cycle
118	21	25	33	39	66	78
208	65	78	102	123	204	245
236	83	100	131	157	262	314

F-L Capacitors

Pyranol is General Electric's registered trade name for a noninflammable liquid dielectric for capacitors.

GENERAL ELECTRIC

407-110-5700

REMEMBER

IT'S EVEN MORE VITAL TODAY...

Hundreds of industrial plants today are again risking costly production stoppages, equipment damage, and personnel casualties because of low-voltage protective devices that lack adequate "IC"—interrupting capacity.

Conditions dangerous to personnel and equipment can be corrected and power shutdowns eliminated by acting on the essential facts first set forth in General Electric's "IC" advertising of eight years ago.* They are:

1. *Know the "IC" of your low-voltage protective devices.*

2. *Be sure the "IC" is adequate* to interrupt full short-circuit current.

Maximum short-circuit current is *not* determined by the normal load on the circuit. The total capacity of the transformers feeding the circuit is the critical factor.

It's easy to select the proper G.E. air circuit breakers. They have adequate "IC" to help safeguard your production, equipment, and personnel.

*In the much discussed 1939 "IC" advertising, General Electric repeatedly warned industry of the hazards of using low-voltage protective devices of dubious or insufficient "IC." As a result, many plants checked their "IC" and replaced inadequate devices with air breakers of known "IC." Now, even greater hazards are present as war- and peace-expanded transformer capacity in many plants has outgrown the low-voltage protective devices.

THIS ?

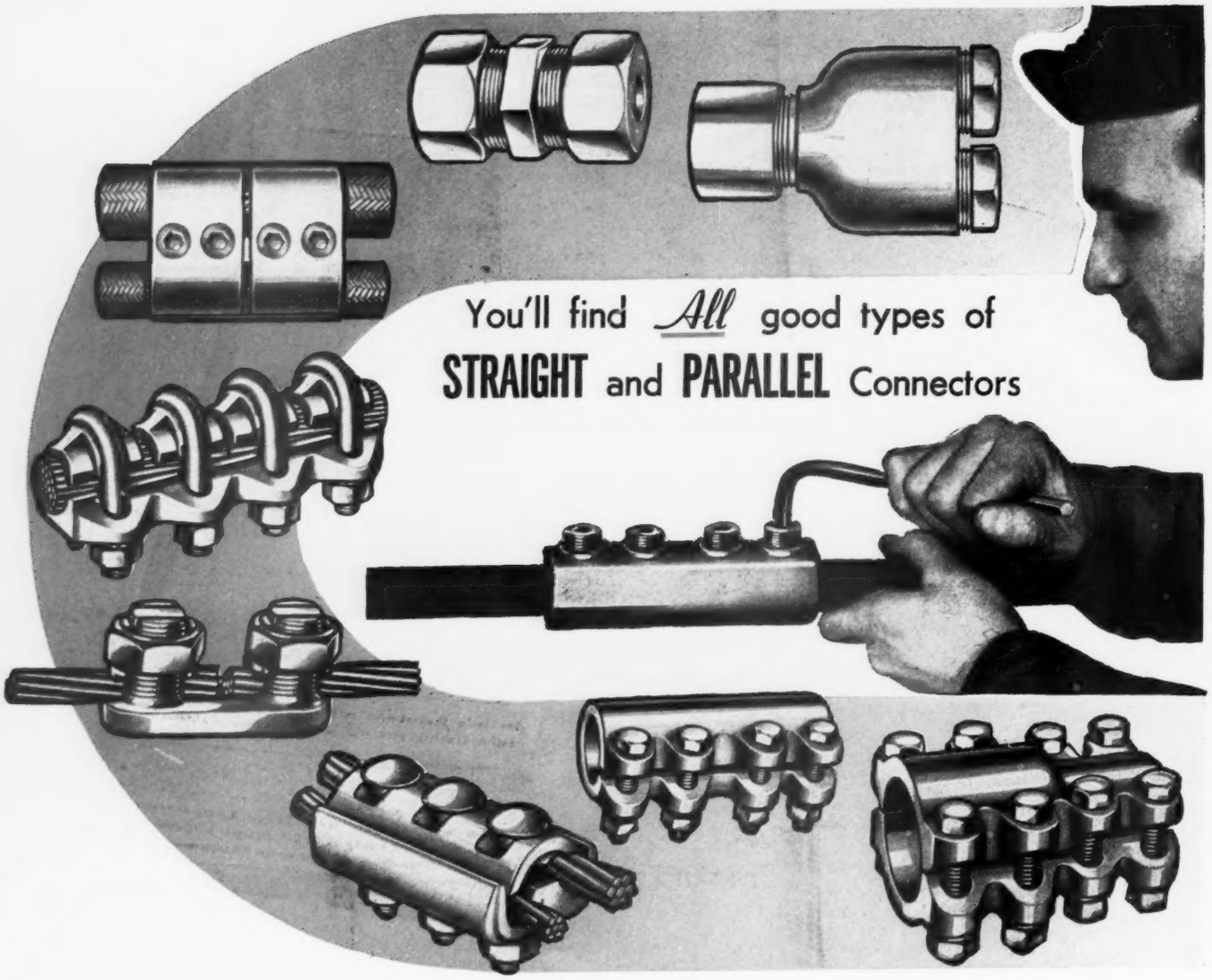
If you check your "IC"
Interrupting capacity
You'll Want to Install Air Circuit Breakers
at Once on Main and Branch Feeders
THEY not only have plenty of "IC" they provide overcurrent protection, with adjustable time delay, and you can restore service at once—by simply turning the handle.
For main feeders—the metal-enclosed, skeleton-constructed switchboard with draw-out-type breakers
For branch feeders—the individual safety-enclosed breaker with plenty of "I.C." Designs available for interrupting currents up to 50,000 amp
YOUR "IC"

Air breakers with adequate "IC" pay off in dollars as well as in safety. They minimize production delays. A turn of the handle and power is restored—no parts to be replaced. By providing *three-phase* interruption of dangerous overcurrents, G.E. air breakers also prevent the harmful single-phasing of motors.

Are you *sure* of the "IC" of the protective equipment in *your* plant? If not, your G-E sales representative will gladly help you. Or write for bulletin GEA-3600 describing air breakers up to 100,000 amperes interrupting capacity. Bulletin GET-1113 explains how to select G.E. air circuit breakers. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

860-28-7500



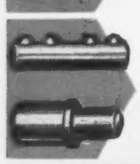
in the *Complete* line

Yes, it's mighty handy to open your Penn-Union Catalog and pick the exact type you need. They're all there—in a complete range of sizes: Bolted straight connectors . . . screw type . . . various split sleeve types . . . shrink fit . . . universal clamps . . . E-Z connectors with yoke and nut, etc.

The Penn-Union Catalog also gives you the *complete* line of Service Connectors, Tees, Cable Taps, Grounding Connectors, Lugs, Power Connectors, etc.

Preferred by leading users—who have found that *"Penn-Union" on a fitting is their best guarantee of unfailing service.*

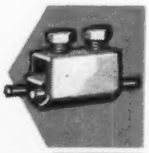
Sold by Leading Wholesalers

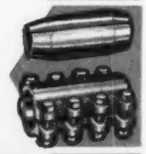


PENN-UNION ELECTRIC CORPORATION
ERIE, PA.

Canada: Dominion Cutout Company, Ltd.
250 Richmond St. West, Toronto

THE *Complete* LINE OF CONDUCTOR FITTINGS





PENN-UNION

Allis-Chalmers New, Smaller, Lighter, Class "B" Insulated Dry-Type Transformers Help This Plant Reduce Electric Distribution Cost!

A MODERN "ALL-ELECTRIC" automobile plant with its hundreds of assembly tools, its fluorescent and incandescent lighting calls for constant, steady voltage at *low distribution cost.*

To get such power economically without line losses and to put power where it was needed — right at load center — this plant's electrical contractor selected Allis-Chalmers Class "B" insulated Dry-Type Transformers.

Why? Because they're ⅓ *smaller, up to 38% lighter* and require *less mounting materials* than conventional Class "A" insulated transformers.

CONTRACTORS LIKE THEM!

Further, these units provide rigid terminal boards with easily accessible clamp connectors, are flexible for mounting almost anywhere, and save secondary copper for the contractor. They save valuable installation time!

POWER USERS LIKE THEM, TOO!

The use of Class "B" insulation makes these attractive, compact transformers safer, longer-lasting . . . they need no fireproof vaults, have no insulating liquids to test, filter or change. Easy installation at load-center ensures steady voltage, saves valuable production time.

Allis-Chalmers Class "B" insulated dry-type transformers are offered to you in 14 sizes ranging from 1½ to 200 kva, single-phase, and 10 to 300 kva, three-phase. For more details call your nearby Allis-Chalmers dealer or sales office, or electrical contractor. Send for Bulletin B6382. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 2138

ALLIS-CHALMERS

★ One of the Big 3 in Electric Power Equipment ★
Biggest of All in Range of Industrial Products

Dry-Type Transformers

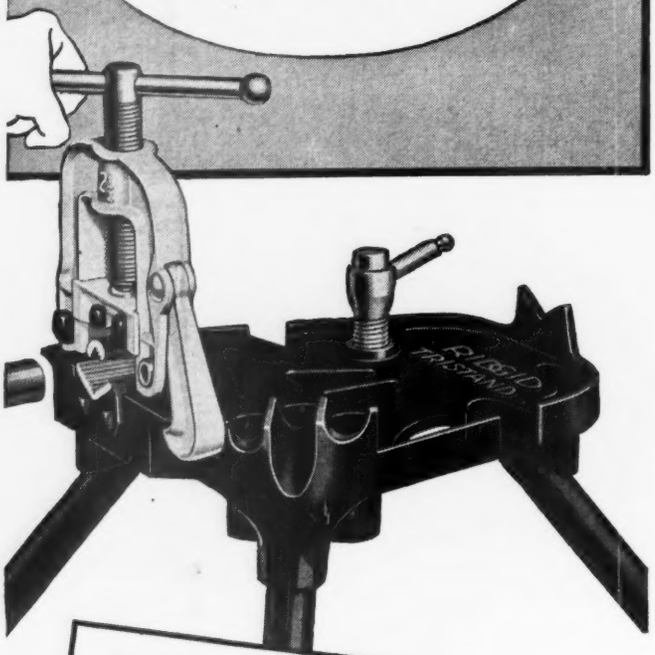
SPEEDY *Pipe Cutting* MADE EASY

Efficiency-balanced RIDGID PIPE CUTTER cuts true, fast, with least effort

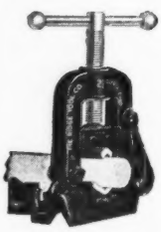
No. 42 4-wheel, fast quarter-turn cutting.

● You save work with this new style RIDGID that rolls through any pipe or conduit fast and easily, leaving practically no burr. Beautifully balanced special malleable frame, its heavy-duty tool-steel wheel always cuts true, every cutter factory tested. Choice of 5 sizes to 6" capacity—4 wheel cutters to 4". Save time and muscle—buy at your Supply House.

A PIPE VISE *That's a handy Work Bench*



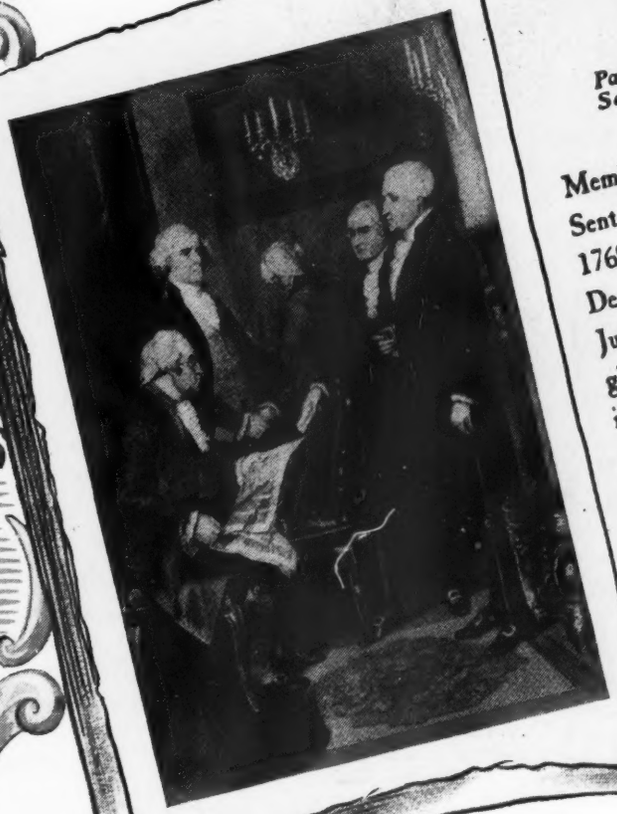
RIDGID TRISTAND is portable and roomy —a big worksaver



RIDGID *Vises include bench, post, stand models, yoke and chain.*

● You can carry the Tristand easily to and around the job—legs fold in—and you've got a convenient work-bench. Big tray for dope pot, oil can, slots for tools, pipe rest for easier cutting and threading, 3 handy benders that won't dent pipe or conduit. Yoke or chain vise with LonGrip jaws, safe for nickeled pipe. A worksaver bargain—buy at your Supply House.

RIDGID WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO



SERVICE

Partial Record of Thomas Jefferson's Services to the United States

Member of the Virginia Convention 1775. Sent to the Virginia House of Burgesses in 1769. Chairman of Committee drafting Declaration of Independence (approved July 4, 1776). Elected Governor of Virginia in 1779 and 1780. Appointed Minister Plenipotentiary to France 1784. Elected Vice President in 1796. Served as 3rd President of the United States 1801-1809.

Thomas Jefferson when he served in the first Cabinet. From left to right: Knox, Jefferson, Randolph Hamilton, Washington.

—*The Bettmann Archive*

5th in a series on Thomas Jefferson, Third President of the United States.

"Yesterday, the last of the year (1825) closed the sixty-first of my continued services to the public." Thus wrote Thomas Jefferson as he neared the end of a life devoted almost exclusively to patriotic services.

As Thomas Jefferson exemplified a life made great by worthwhile service so can we all increase the worth of our personal stock by a high quality of service in whatever undertakings may occupy us. The Jefferson Electric Company continues to extend all its efforts toward a type of service which reflects promptness, care and appreciation.

***TRANSFORMERS:** Power Circuit, Mercury Lamp, Oil Burner Ignition, Control, Bell ringing, and Luminous Tube.*
***FUSES:** Jefferson-Union Renewable Fuses, Super-Lag, and Non-Renewable. BALLASTS for Fluorescent Lamps.*

JEFFERSON ELECTRIC COMPANY

BELLWOOD, ILLINOIS *(Chicago Suburb)*

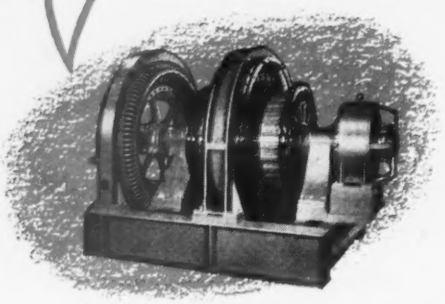
In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Ave., Toronto, Ont.

JEFFERSON ELECTRIC

SPECIALIZATION MEANS PROVED PERFORMANCE

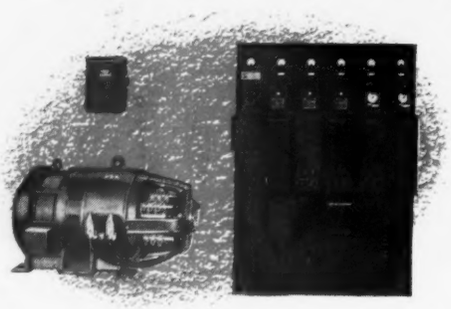
● For 35 years, The Electric Products Company has specialized in the manufacture of High-Current, Low-Voltage Motor-Generators and other special electrical equipment. The result is Proved Performance . . . an assurance of lower-cost operation, higher operating efficiency and more dependable life-time service. For every application, E.P. designs and builds equipment that fits exactly the requirements of the particular operation.

FOR EXAMPLE:



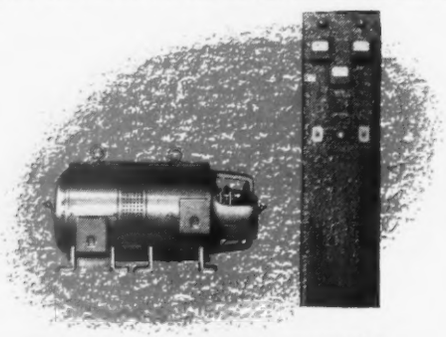
FOR ELECTROLYTIC PROCESSES

E.P. Electrolytic Motor-Generators employ *Undercut Commutator Mica* to prolong commutator and brush life; *Pole Spacers* to help assure sparkless commutation; *Micrometer Adjustment of Interpoles,* an exclusive feature, to guarantee outstanding performance; *Correct Mechanical Design* that means every part of the motor-generator is swept by a cooling stream of air; and *Fully Accessible Construction* for easy inspection.



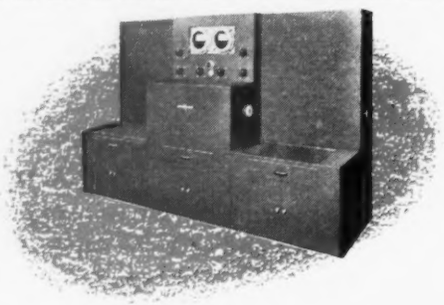
FOR INDUSTRIAL-TRUCK BATTERY-CHARGING

In 1910, The Electric Products Company introduced the first Automatic Battery Charger. Today they most efficiently and advantageously combine: completely automatic operation . . . the modified constant-voltage method of charging . . . individual application design . . . elimination of complicated control or ventilating systems . . . and specialized low-voltage designing.



FOR STANDBY BATTERY-CHARGING

Since 1923, Diverter-Pole Motor-Generators have proved to be the most reliable, maintenance-free and efficient source of direct current for Control Bus Battery Charging. They assure maximum battery life, give full-automatic operation and protect themselves against harmful overloads. Requiring only infrequent inspection, they are extensively used in isolated automatic and supervisory-controlled substations.



FOR INDUSTRIAL TESTING

The design and manufacture of Dynamometers, because of the very high operating speeds and the severe continuous-duty loads, require a manufacturing skill far beyond that needed for conventional equipment. The Electric Products Company has developed this background. Features include oversize bearings, heavy supports and framework, special commutator and armature construction.

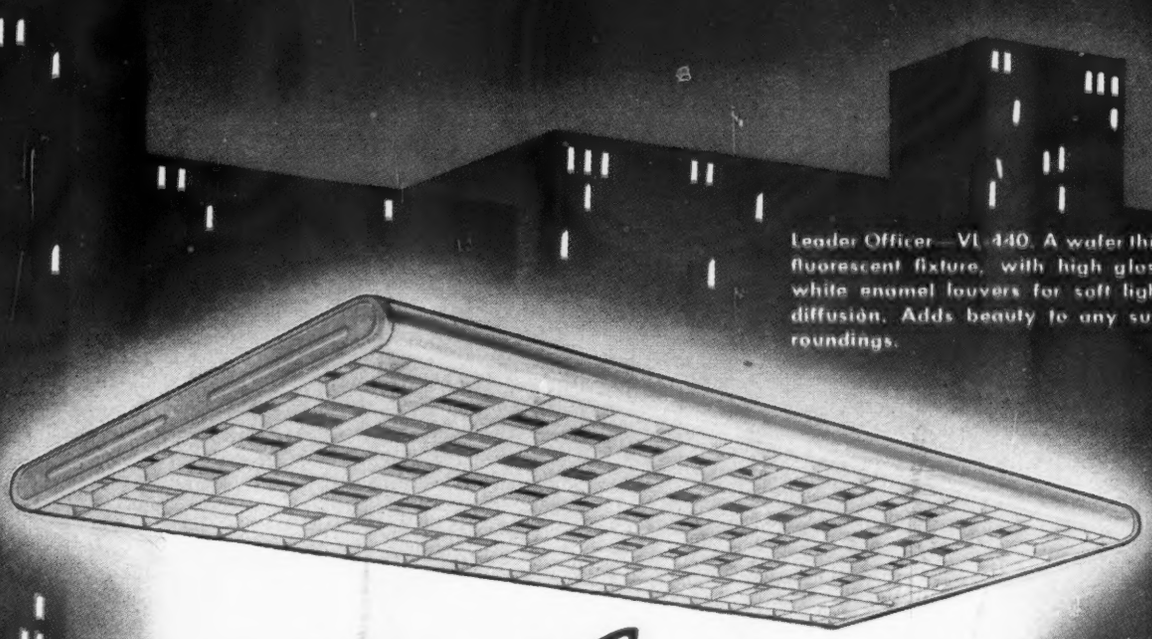
● **Get the Facts on these and other E.P. Products . . .** For complete information, please contact your nearest E.P. representative or write to the address shown below:

EP

X-29

THE ELECTRIC PRODUCTS COMPANY

1734 CLARKSTONE ROAD CLEVELAND 12, OHIO

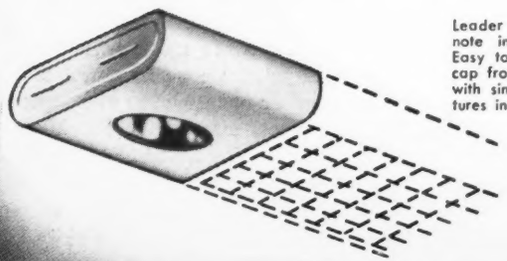


Leader Officer—VL-440. A wafer thin fluorescent fixture, with high gloss white enamel louvers for soft light diffusion. Adds beauty to any surroundings.

modern business chooses the *Leader* "OFFICER"

Banks, offices, department stores and exclusive shops, airport and railway stations—every type of commercial institution where beauty and better light are important—unanimously choose Leader's modern Officer unit. It's America's most versatile fixture—use it as a single unit or in continuous runs—mount it with stem and canopy or flush with ceilings. For every commercial need, choose the "Officer."

Leader's complete line of fluorescent fixtures is distributed only by better electrical wholesalers. There is a friendly Leader representative in your area.



Leader Adjustable Direclite—A new note in "spotlight" merchandising. Easy to install—simply remove end cap from any "Officer" fixture. Use with single fixture or between fixtures in a series.

LEADER ELECTRIC COMPANY

6127 NORTH BROADWAY • CHICAGO 40, ILLINOIS

WEST COAST FACTORY • 2040 LIVINGSTON STREET • OAKLAND 6, CALIF.

WHY FIBERGLAS TAPE IS USED ON *Induction Furnace Coils*

In metal-melting furnaces, high temperatures create tough insulation problems. For example, around the Fiberglas-insulated coils, in the furnaces made by the Ajax Engineering Corporation, Trenton, N. J., temperatures are in excess of 300° F. from radiation and conduction alone. And the internal heat from the coil itself boosts the operating temperature considerably higher.

Tape woven from Fiberglas yarns, is wrapped around the copper conductors, the coils are formed, then dip-impregnated with modified phenolic high-temperature insulating varnish.

This is typical of many applications in which Fiberglas, in various forms, is being used to provide a margin of safety in electrical equipment. For Fiberglas withstands heat far beyond the temperature range of even the newer insulating varnishes. Moreover, should the impregnants burn out, the Fiberglas base still provides protection as a permanent spacer.

Fiberglas Electrical Insulating Materials are available in forms to meet practically every insulation need. If you are concerned with the design, manufacture, use or maintenance of electrical equipment, get all the facts about Fiberglas Electrical Insulations. Write for catalog EL46-11—Owens-Corning Fiberglas Corporation, Department 856, Toledo 1, Ohio. Branches in principal cities.

In Canada: Fiberglas Canada Ltd., Toronto, Ontario.

OWENS-CORNING

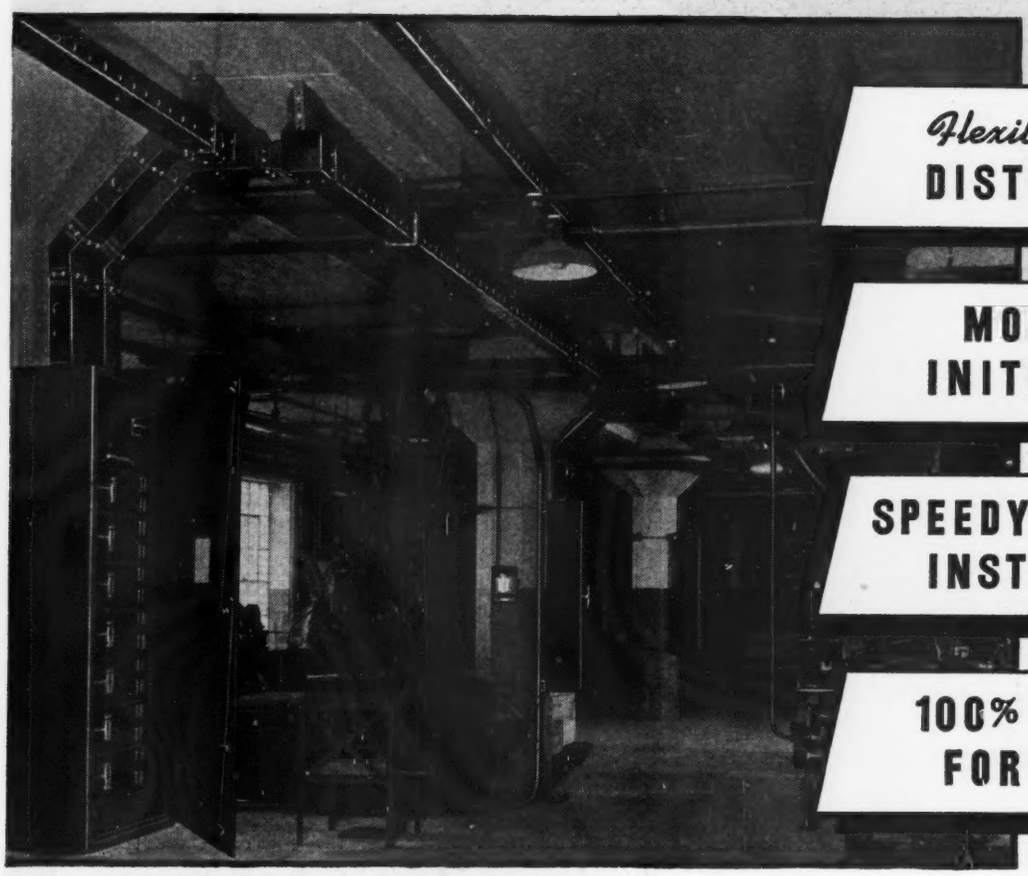
FIBERGLAS

Reg. U.S. Pat. Off.

ELECTRICAL INSULATING MATERIALS

TAPES • CLOTHS • BRAIDED SLEEVING • VARNISHED TUBING • MICA COMBINATIONS • LAMINATES

SQUARE-Duct *offers...*



Flexible **POWER DISTRIBUTION**

MODERATE INITIAL COST

SPEEDY, LOW-COST INSTALLATION

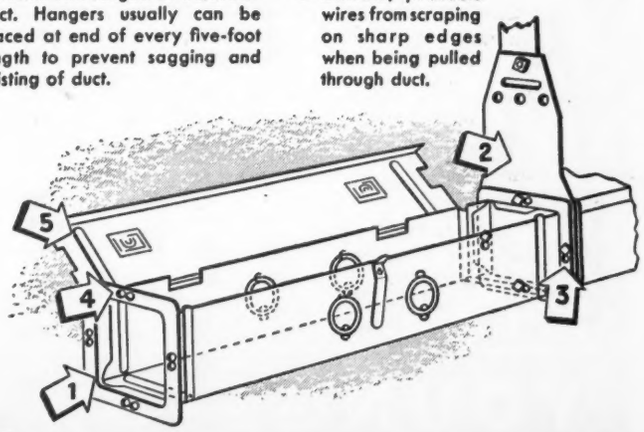
100% SALVAGE FOR RE-USE

Power where you want it—when you want it—without buying or moving long runs of conduit.

That's why so many plants use SQUARE-Duct to carry feeders, branch circuits, and other groups of conductors. SQUARE-Duct saves time and money every time a machine is moved or a new one added. Knockouts every three inches along the duct provide complete flexibility of machine location. Circuits are easily accessible for inspection or maintenance.

The initial cost of SQUARE-Duct is comparable to that of conduit wiring. Installation cost is substantially lower. For complete details . . . call your Square D Field Engineer, or write Square D Company, 6060 Rivard Street, Detroit 11, Michigan, for Bulletin 6000.

1. Drawn collar affords secure support for the duct and automatically aligns each length to prevent twisting. It also serves as a stable connection to the adjacent length equipped with a similar collar.
2. Notice how hanger fits securely between two lengths of SQUARE-Duct. Hangers usually can be placed at end of every five-foot length to prevent sagging and twisting of duct.
3. Hanger is bolted to both sides, top and bottom, affording even distribution of weight and offsetting any tendency to twist.
4. Double keyhole screw slots help in making alignment adjustments.
5. Emboss on cover, both sides and bottom, protects wires from scraping on sharp edges when being pulled through duct.



SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*

It's time to insist on SAFE wiring again

NOT so long ago, material shortages and other emergency demands forced practices on the electrical industry that did not meet code requirements. For example, people got temporary permission to use open wiring, and other less-than-safe systems.

Now that the emergency is past, common sense dictates a return to safe practice. Temporary wiring should be replaced. In new construction, only the best methods should be followed--and in electrical construction "best" means "safest."

REMEMBER that the only wiring system approved by the National Electrical Code as moisture, vapor, dust and explosion proof in hazardous locations is a standard-threaded rigid conduit.

Youngstown's "Buckeye" is the most widely used full-weight, rigid-steel conduit in the world. It is stocked and sold by leading electrical distributors in every industrial market. Specify "Buckeye" and be safe.

BUCKEYE YOUNGSTOWN CONDUIT

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

GENERAL OFFICES · YOUNGSTOWN 1, OHIO

Export Offices · 500 Fifth Avenue, New York City

Manufacturers of

CARBON · ALLOY AND YOLOY STEELS

Ask your distributor for:
Youngstown Buckeye Conduit...Pipe and Tubular Products...Sheets...Plates...Electrolytic Tin Plate...Coke Tin Plate...Bars...Rods...Wire...Tie Plates and Spikes

Industry Approval...

the test of any product

Send for factual literature on any American bodies, ladders, or Tower Lift. (Illustrated — Crew Compartment B-4).

● The power, light, gas, and communications industries have been co-operating with us for 30-odd years. This close association has resulted in the kinds of bodies you need to maintain your high standards of service at lowest cost.

Standardization has been the key of the effort. As a result, American bodies have become industry standards. They include —line construction, light line service, general service and meter installation, utility, crew compartment, maintenance, installation, tree trimming and others.

We expect to continue to merit your industry's approval.

ACB

THE *American* COACH and BODY COMPANY

9503 WOODLAND AVE., CLEVELAND 4, OHIO

SALES and ASSEMBLY THE AMERICAN COACH AND BODY CO. OF CALIF., 432 FIFTH ST., OAKLAND 7, CALIF.
BAKER EQUIPMENT ENGINEERING CO., SUMMIT & NORFOLK STS., RICHMOND 11, VA.

OFFICES 350 MADISON AVE., NEW YORK 17, N. Y. INSURANCE EXCHANGE BLDG., DES MOINES 9, IOWA

8 *reasons why you should specify*

WIRE AND CABLE INSULATION MADE FROM

GEON *plastics*

for industrial, domestic, manufacturing and utilities wiring

Resistance to ozone, wear, sunlight, water, chemicals, and most other normally destructive factors

14 colors including NEMA standards

More conductors in a given space

Excellent electrical properties

Thin coating of insulation

Ease of handling

Easy stripping

Light weight

Be sure to specify wire or cable insulated with GEON in order to get *all* these advantages. Or, for information regarding special applications please write Department H-3, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ont.

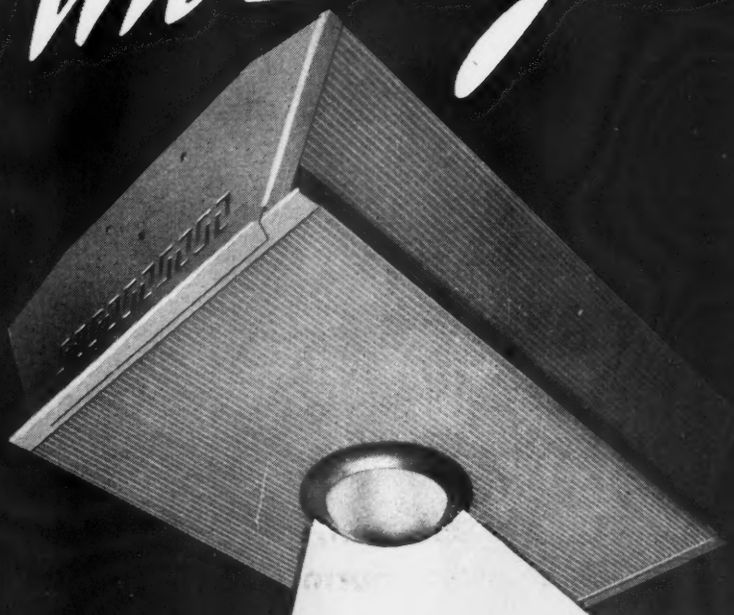
B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE brand chemicals

It's the Bright Spot

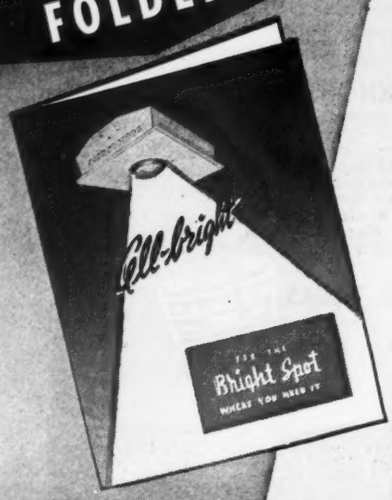
THAT COUNTS



MERCHANDISE UNDER THE BEAM *With* All-bright RIGHT SPOT UNITS

ALL-BRIGHT—the duo-purpose, compact, space-utilizing, display light of tomorrow. One unit combines a soft-focus aura of light for background and an incandescent flood to spot and dramatize and increase sales. Before planning to build or remodel your office, factory or store display, see All-Bright—the fixture of the future!

SEND FOR ILLUSTRATED FOLDER



R. S. U.

NAME _____

ADDRESS _____

CITY AND STATE _____

IGHT RIGHT WITH ALL-BRIGHT

All-bright ELECTRIC PRODUCTS COMPANY
3917 - 25 N. KEDZIE AVENUE • CHICAGO 18, ILLINOIS

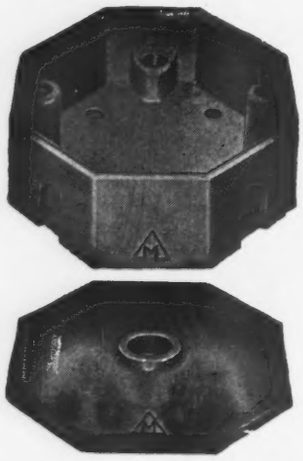
ILLINOIS
PORCELAIN WIREHOLDER INSULATORS

Insure SAFE HOUSE SERVICE CONNECTIONS..

• When you use Wireholder Insulators with the name "ILLINOIS" you are backing up your work with the right quality for the job.

All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by a special process to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.

OUTLET BOXES



Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.

ALL-PORCELAIN ILLINOIS SYSTEMS

for outstanding, adequate and modern wiring jobs

SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of the best quality of white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.

Bull Dog

KNOBS

Cement coated — extra length nail—genuine leather washer — code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.

STANDARD TUBES

in sizes 1/2 to 48 inches, 5/16 to 3 inches diameter in following types: unglazed, glazed, split, floor split floor, headless, curved and, crossover split, and cross over. Diameters all uniform both inside and outside.

ILLINOIS ELECTRIC PORCELAIN COMPANY *Macomb, Illinois*

"LVR" ENGINEERING makes it easier to sell ENGINEERED LIGHTING

✳ FOR BUSINESS OFFICES

Office of Western Grain Co., Birmingham—effectively lighted by Spero "LVR" fixtures

"LVR" MEETS THE 3 BASIC REQUIREMENTS FOR GOOD "ENGINEERED LIGHTING" . . .

1. **HIGH EFFICIENCY**—Light from the 40W tubes is shielded by evenly spaced louvres. Individual reflector for each tube—finished in "Plastox" white (86% reflection factor).

2. **LOW MAINTENANCE**—Starters accessible without disturbing tubes or hinged louvres. Relamping is done from top. Individual reflectors removable for each cleaning.

3. **SMART APPEARANCE**—End pieces, canopy and stems finished in pearl gray. Plastic side panels add to appearance and utility. Attractively styled.

Write for complete engineering data.

Spero also manufactures REFLECTORS, FLOODLIGHTS, VAPOR PROOF UNITS, and various MATERIALS FOR ELECTRICAL CONSTRUCTION. Write for Bulletin No. 10.

FACTS and FIGURES

FIXTURES—46 Spero "LVR-448" Fluorescent Luminaires.

MOUNTING—Pendant, 36" stems. Continous rows, 9 ft. apart. Height from fixtures to floor, 9 ft.

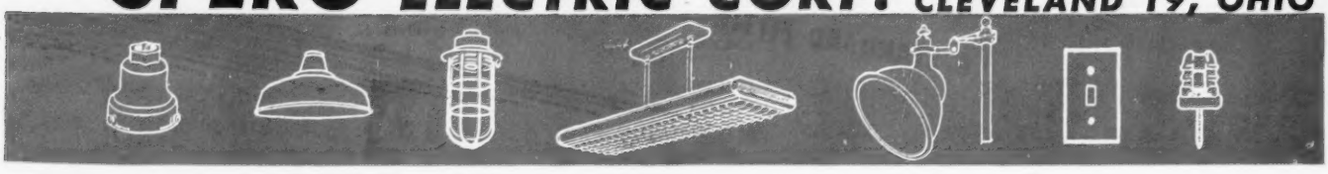
COLOR SCHEME—Ceilings white (80% reflection factor); walls light pastel green (72% reflection factor).

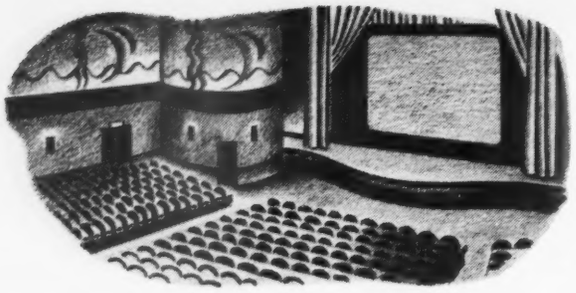
RESULT—60 footcandles of low brightness illumination of the intensity recommended for detailed visual tasks.

Installation made by Birmingham Armature Electric Company, fixtures sold through National Distributors, Inc.

✳*One of a series. Other advertisements show "LVR" engineered lighting in store interiors, institutions, etc.*

The SPERO ELECTRIC CORP. 18222 LANKEN AVE. CLEVELAND 19, OHIO





FOR THEATER WIRING

The Modern Way is

Simple compression-type fittings eliminate any need for thread-cutting with ELECTRUNITE E.M.T. You merely slip the coupling on the two lengths to be joined, tighten the two compression nuts, and you have a strong, water-tight joint that will withstand vibration without loosening. Box connectors operate on the same principle.

12 Advantages

1. FULL PROTECTION
2. NO THREAD-CUTTING
3. INCH-MARKING
4. LIGHT WEIGHT
5. EASY TO BEND AND REBEND
6. STANDARD FITTINGS
7. EASY TO INSTALL
8. UNBROKEN CORROSION-RESISTANCE
9. KNURLED INSIDE SURFACE
10. UNIVERSAL ACCEPTANCE
11. LOW COST
12. WIDESPREAD DISTRIBUTION

the Electrunite Way

ELECTRUNITE E. M. T. SAFEGUARDS WIRING WITH *SOLID WALLS OF STEEL,* PLUS AN ***UNBROKEN*** COATING OF PROTECTIVE ZINC

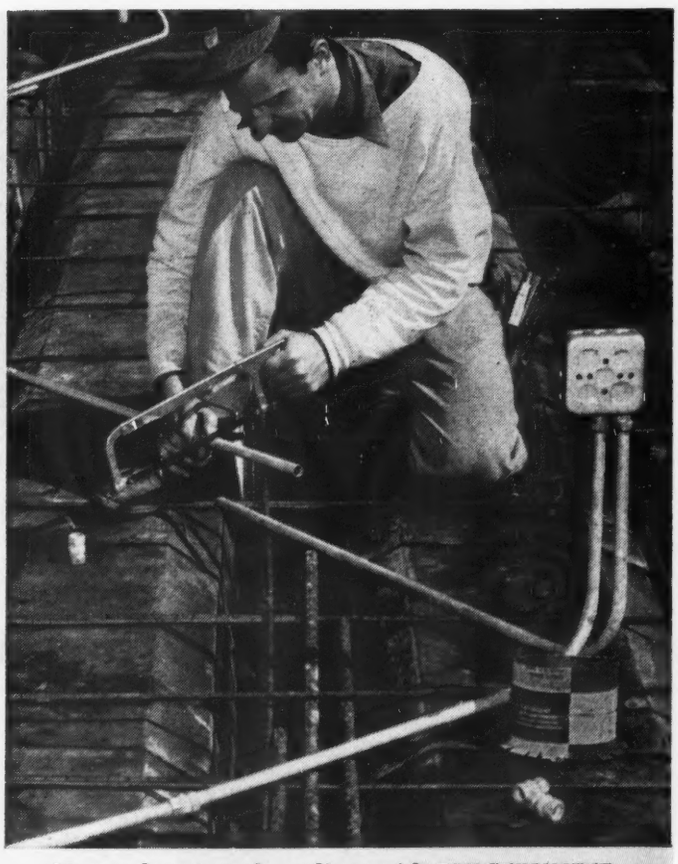
No need to worry about corrosion troubles when you install Republic ELECTRUNITE E.M.T., the *original* lightweight rigid steel raceway that provides continuous, unbroken corrosion protection throughout the entire raceway installation.

Unlike other types of conduit, modern ELECTRUNITE E.M.T. never requires thread-cutting or turning into the fitting. Hence its tightly adherent zinc coating remains unbroken at coupling and box connector—unmarred, too, by biting pipe wrench teeth.

This is but one of the many reasons why easy-to-install ELECTRUNITE E.M.T. merits the Underwriters' Laboratories inspection seal, indicating that it provides adequate mechanical and electrical protection . . . reason also why it is approved by the National Electrical Code for exposed, concealed and concrete slab construction.

REMEMBER: You can be sure that any wiring job is safe when it's run through dependable, long-lasting raceways of ELECTRUNITE E.M.T. Like more information? See your nearest ELECTRUNITE Distributor, or write to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

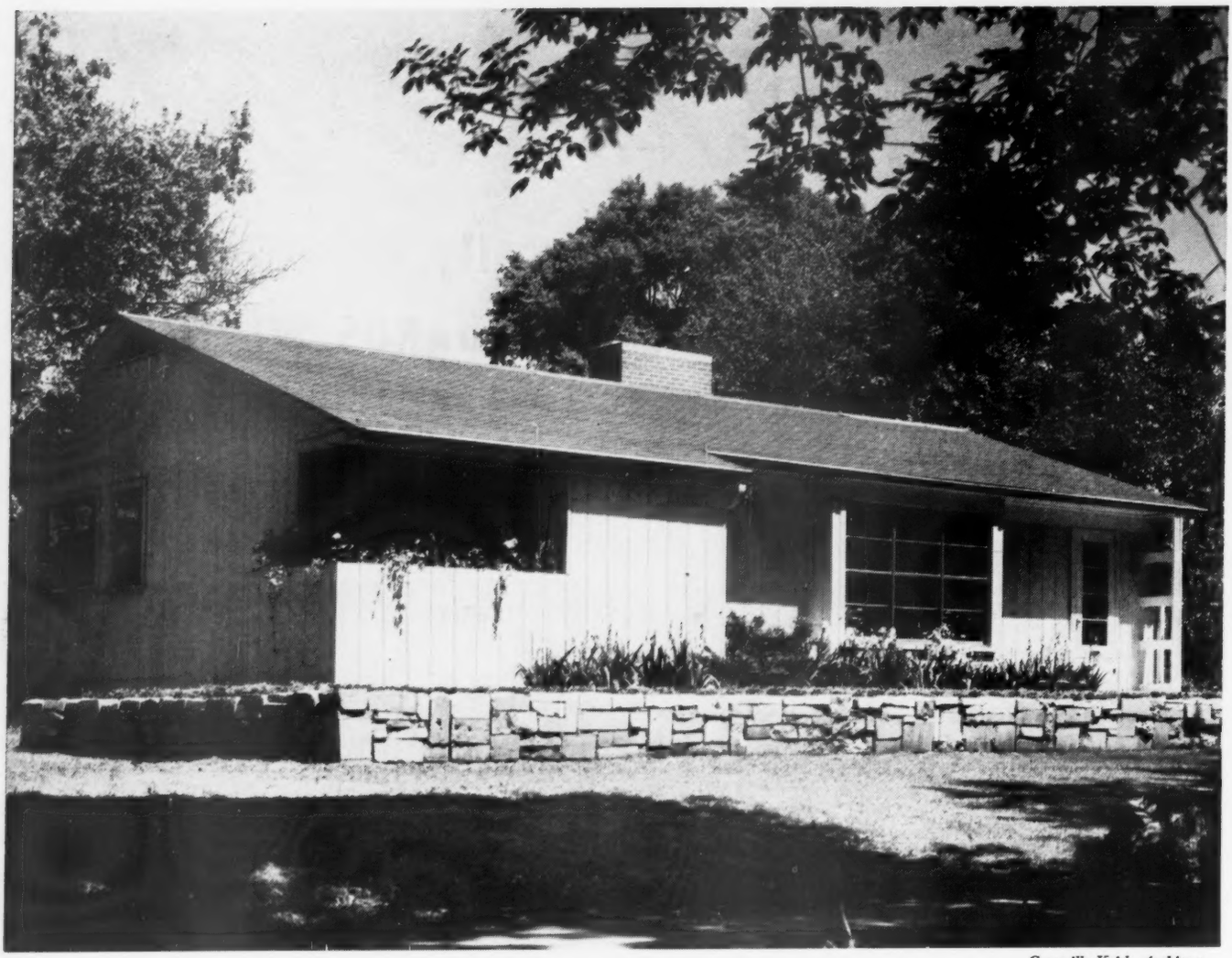


No need to turn long lines with ELECTRUNITE E.M.T. Just cut the tube, insert the coupling, tighten with wrench or pliers . . . that's all there is to it.

REPUBLIC STEEL REG. U. S. PAT. OFF.

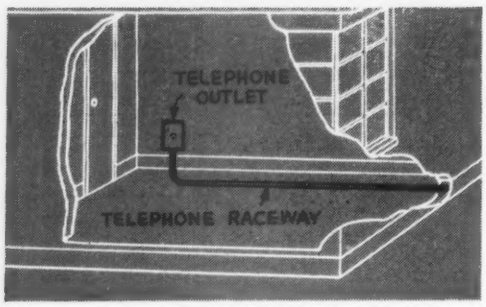
Republic
ELECTRUNITE E.M.T.
REG. U. S. PAT. OFF.

LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY



Granville Keith, Architect

EVEN MODERN MIDGETS SHOULD BE "TELEPHONE CONDITIONED"



What the up-to-the-minute home misses in size can be made up for in planning. For one thing, a raceway for concealing telephone wires will give more convenience to the owner—more profit to you.

When there is no basement, the telephone installer generally cannot run wires up through the floor to the telephone location. But a simple wiring channel *installed before the floor is laid* avoids attaching telephone wires in plain sight on baseboards and around window and door frames.

Remember — NO ELECTRICAL CONTRACT IS REALLY COMPLETE UNLESS IT INCLUDES A RACEWAY FOR TELEPHONE WIRING FACILITIES.

BELL TELEPHONE SYSTEM

BETTER WIRE CONNECTIONS actually cost you less with IDEAL Wire-Nuts*

(THE SOLDERLESS, TAPELESS WIRE CONNECTORS)

Save dollars and speed work on roughing in, fixture hanging and countless other wiring jobs

It only takes a fraction of a minute to make a positive, dependable connection of any usual combination of wires with an IDEAL "Wire-Nut". Just turn a "Wire-Nut" onto the stripped ends of the wires; the tapered spring insert automatically twists the wires together and *presses* clean, solid-grip threads into them. You get a permanent, compact joint . . . quick and easy.

Better electrically—stronger mechanically—

Laboratory tests *prove* that Ideal "Wire-Nuts" stand up to 3 times as much pull as the best soldered joints. Electrically, a "Wire-Nut" joint has as much as 25% less resistance than a similar soldered joint. IDEAL "Wire-Nut" connections are non-corrosive and highly resistant to heat and vibration.

IMMEDIATE DELIVERY from wholesalers' stocks everywhere

Thousands of Electrical Contractors have proved to themselves how "Wire-Nuts" save money and speed work. Convince yourself—get "Wire-Nuts" from your wholesaler for your very next job. Sizes for all usual combinations of wires.

YOU DON'T NEED Solder, Tape, Drip Pot, Iron or Torch to make a Strong, Safe Wire Joint!

Two fast, simple operations make a neat, craftsmanlike joint with an IDEAL "Wire-Nut". Save materials and speed work. Millions in use. A size for every need.

Approved

IDEAL "Wire-Nuts" are listed by Underwriters' Laboratories, Inc. and Approved by Factory Mutual Laboratories.

*Trade Mark Reg. U. S. Pat. Office

Free **APPLICATION MANUAL**

Get your copy of this book that shows how and where to save money on every wire connection you make. Mail coupon today.

BUY "WIRE-NUTS" from YOUR JOBBER

IDEAL

IDEAL INDUSTRIES, Inc.

Successor to Ideal Commutator Dresser Co.

1041 Park Avenue • Sycamore, Illinois

FREE SAMPLES—Mail Coupon

IDEAL INDUSTRIES, Inc.
1041 Park Avenue, Sycamore, Illinois

Please send Free Samples of Wire-Nuts and Free Application Manual.

Name_____

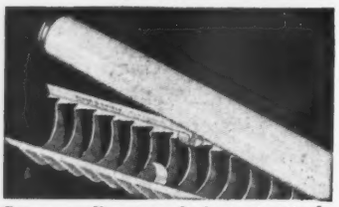
Company_____

Address_____

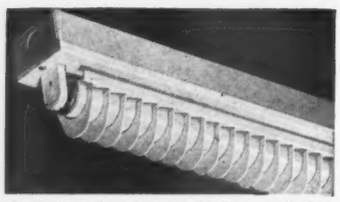
City_____ State_____

This photo was taken in the Law Library, Loyola University Loop Center, Chicago, Illinois, and illustrates efficiency and attractiveness of Fluor-O-Shields.

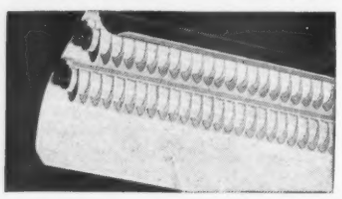
No trick to install Fluor-O-Shields. Just snap them on. No bolts or tools needed.



Snap-on clips permit instant attachment or removal for changing burned out lamps.



No flat surfaces to catch dust and dirt. 92% of the light and none of the glare.



3 sizes to fit most exposed lamp fixtures. For continuous or unit mounting.

Light weight, ease of attachment and all around efficiency make Fluor-O-Shield the most practical light diffuser on the market.

How a glare problem was solved at Loyola University

Fluorescent lighting is the most modern way of lighting today, but it also presents the problem of glare. The installation of eleven hundred fluorescent fixtures in the classrooms and libraries of Loyola University's loop center at 820 N. Michigan Ave., Chicago, required the use of some sort of light diffuser.

The ceilings are 9′ 5″ and fixtures were placed parallel to general vision direction (see illustration above). To produce an even intensity of light at reading level, Fluor-O-Shields (a total of 2,200) were specified for each of the 2-tube 40 watt fixtures by the lighting engineers. This is the most practical and economical way known to get the most efficient lighting with the least amount of glare.

Fluor-O-Shields are endorsed by lighting engineers, lamp tube manufacturers and electrical testing laboratories for use in factories, offices, schools—wherever good lighting is essential to better working conditions. For more data, specifications and information, write to address below.

THREE SIZES

$1.95 40 watt 46⅞ inch

$1.25 20 watt 22⅞ inch

NEW!

$2.95 100 watt 58⅛ inch

Aluminum finished in white baked enamel

FLUOR-O-SHIELD*

Light Diffuser for Fluorescent Lamps

*Trade Mark—Patent Pending.

CAMFIELD MANUFACTURING COMPANY • GRAND HAVEN, MICHIGAN

Cutler-Hammer Announces

THE TYPE MO 4 MULTI-BREAKER

Cutler-Hammer Engineered and Manufactured to Cutler-Hammer Standards of Dependability.

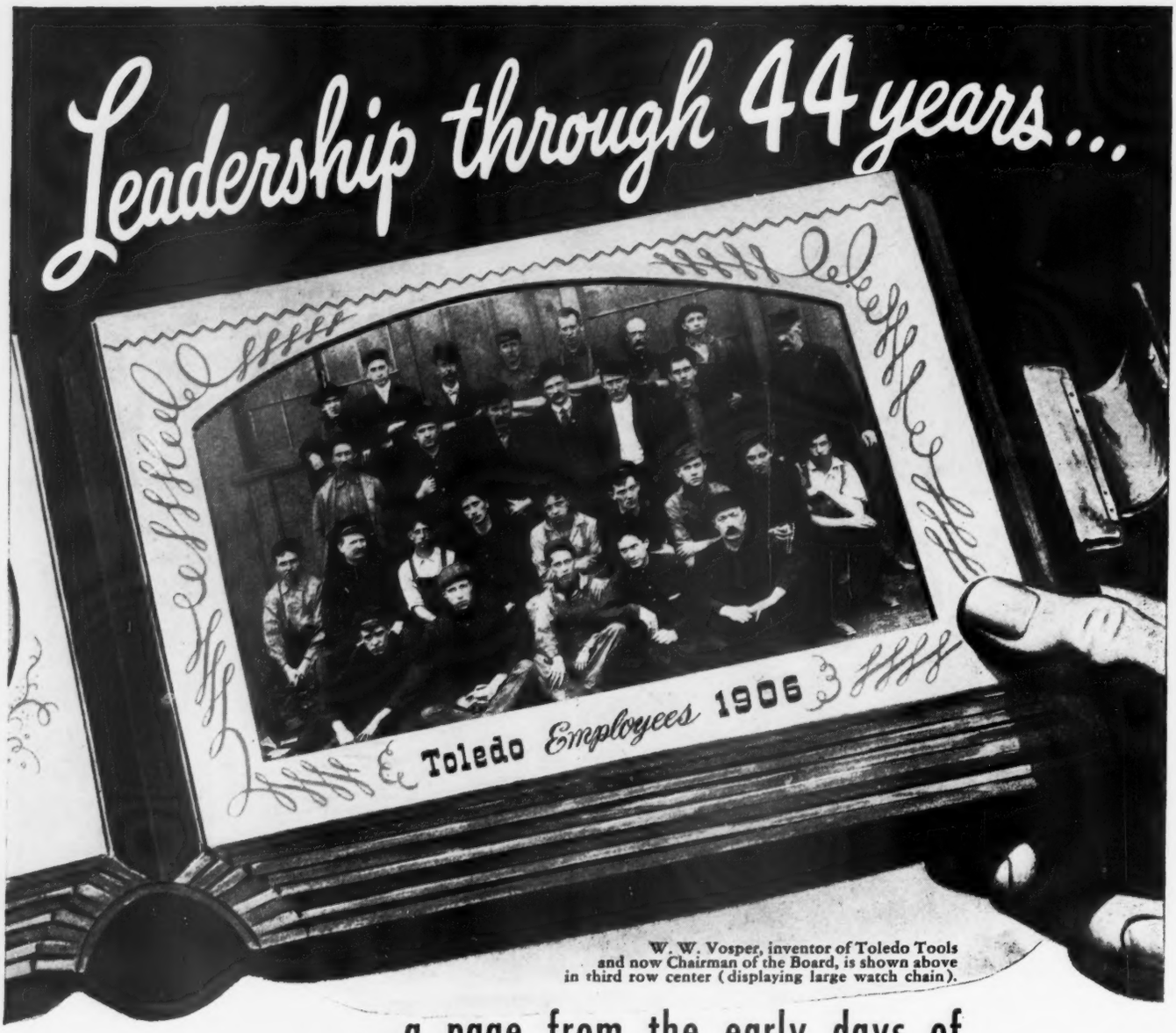
This new small size Multi-Breaker measures only 5″ x 7″, yet has 4 poles, with circuit ratings of 15, 20, 30 amperes, and has thermal and magnetic trip heretofore found only in industrial type Multi-Breakers. The magnetic trip operates instantly on short circuits. The thermal trip holds on harmless overloads.

The two top or two bottom poles can easily be connected for double pole circuits by using the tie bars provided.

The Cutler-Hammer MO 4 Multi-Breaker is available for flush or surface mounting. It is engineered and manufactured throughout to world famous Cutler-Hammer standards making it unusually rugged and dependable.

There is a wide market for the Cutler-Hammer MO 4 Multi-Breaker in new housing of every type, stores, homes, offices, factories, schools and shops. In some cases the MO 4 can be used as a service entrance switch, in other cases as load center protection. Feature and show the Cutler-Hammer MO 4 Multi-Breaker at every opportunity. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
MULTI-BREAKER
C-H



W. W. Vosper, inventor of Toledo Tools and now Chairman of the Board, is shown above in third row center (displaying large watch chain).

...a page from the early days of

TOLEDO PIPE TOOLS!

Experience means a lot in building any product. In the field of pipe fitting—there's a wealth of engineering and manufacturing know-how behind all pipe tools and power pipe machines bearing the famous TOLEDO trademark!

Toledo experience goes back 44 years... to the days of the Iroquois Theatre fire... the Wright Brothers' first airplane flight... and the start of the Panama Canal. Through the years—Toledo has jealously guarded its reputation for producing top-quality tools... of high accuracy and dependability. ... available to you at low prices.

The long-term service record of our employees is also important to you—assuring better products and better service. The *average term* of employment is—Factory employees... 12 years • Working supervisors... 23 years • Foremen... 27 years • Salesmen... 12 years • Officers and Dept. Managers... 29 years.

Toledo is proud of this record of service and it assures the hundreds of thousands of Toledo users that Toledo Tools and Power Pipe Machines are of the highest standard of quality and efficiency. When you tool up with Toledo you are tooled up *right!* Our distributors—your dealer—will serve you. The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Building.

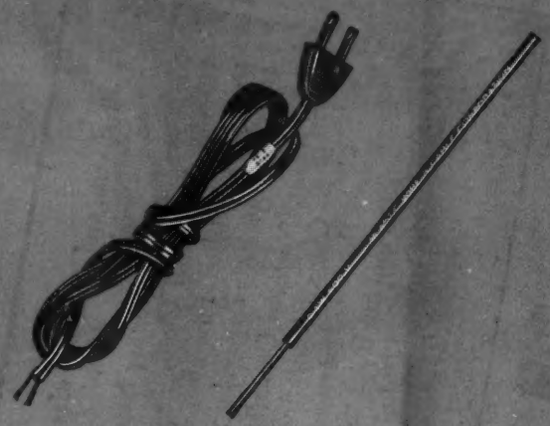
Toledo No. 1 Plain 1" to 2" Threader pioneered the Toledo line and is still preferred by many users today.

"TOLEDO" TRADE-MARK REGISTERED

TOLEDO

PRECISION PIPE TOOLS

ARE YOUR WIRE NEEDS *Standard or Super Special?*



No matter *how* you use it, wire or cable insulated with PLASTICON will serve you better because of one or more of PLASTICON'S ten basic characteristics.

The user of "special" wire benefits particularly because hitherto impossible specifications are being met to the letter in PLASTICON products developed to specific applications by the engineers of America's largest exclusive manufacturer of plastic wire and cable products.

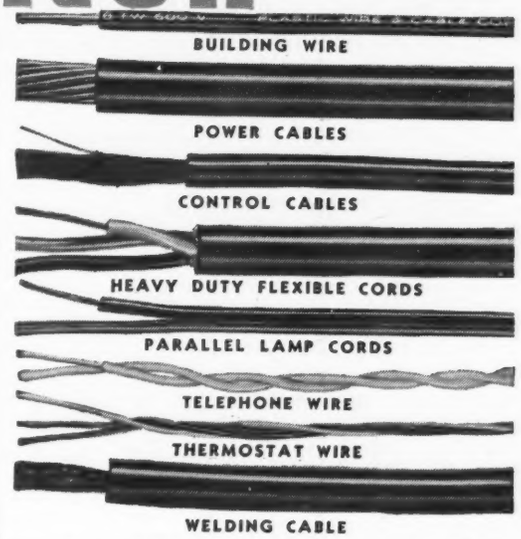
For instance — one of America's leading manufacturers of hearing aids, who depends on PLASTICON for strength, flexibility, and exact coloring. Or the largest producers of heat regulating devices, who use a specially developed PLASTICON wire.

Wire or cable is better if it is plastic insulated, because of the superior adaptability of plastic. Plastic insulation is at its best if it's PLASTICON, the trade name of Plastic Wire & Cable Corporation. Write for free booklet of technical data on PLASTICON insulation, and explain your requirements, or let us tell you how we can meet them with PLASTICON.

PLASTICON

PLASTICON 10 WAYS BETTER

1. *Greater Dielectric strength.*
2. *Cannot fray, crack or rot.*
3. *Low moisture absorbtion.*
4. *Greater mechanical strength.*
5. *Higher abrasion resistance.*
6. *Flexibility at all temperatures.*
7. *High chemical resistance.*
8. *Wide range of permanent gem-like colors.*
9. *Non-combustible.*
10. *Lasting appearance.*



PLASTIC WIRE & CABLE CORPORATION, 403 East Main Street, Jewett City, Conn.

NATVAR *in* CHINA!

This ad appeared in Shanghai newspapers when the first shipment of Natvar insulation arrived after the war.

NATVAR ATTENTION

To all electric and radio manufacturers! Best electrical insulating material from the National Varnished Products Corp. of U. S. A. Including Newest Type Extruded Vinyl Tubings. Varnished Fiberglas. Varnished Silk & Rayon. Papers. Varnished tubings and sleevings. Varnished identification markers. Lacquered tubings and sleevings. Extruded Vinylite tubing. Extruded Vinylite identification markers.

Sole Agent, *(Northern China):—*
China Engineering & Trading Co.,
Room 124 Sassoon House,
Nanking Road, Shanghai., Tel. 14536

Sole Agent, *(Southern China & Formosa):—*
Gilman & Co., Ltd., Hongkong, China.

• Natvar insulating materials are gaining world-wide recognition for the same reason that they are accepted as standard in the United States: Users have found that they can rely on Natvar insulation to be consistently up to specifications or above.

This uniformity is not accidental. It takes constant, continuous, conscientious attention to every last manufacturing and testing detail.

If you require insulating materials with good physical and electrical performance characteristics, and exceptional uniformity—plus prompt delivery—it will pay you to use Natvar. Get in touch with your Natvar distributor or with us direct.

Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded Vinylite tubing
- Extruded Vinylite identification markers

Ask for Catalog No. 20

THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE
RAHWAY 7-2171

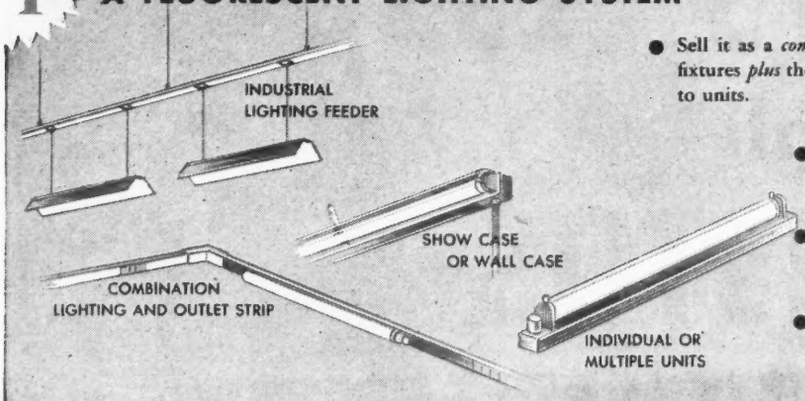
CABLE ADDRESS
NATVAR: RAHWAY, N. J.

205 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY

TODAY'S GREATEST BUSINESS-BUILDING OPPORTUNITIES ARE WIDE OPEN TO EVERY ELECTRICAL CONTRACTOR WHO USES

PLUGMOLD NO. 2100

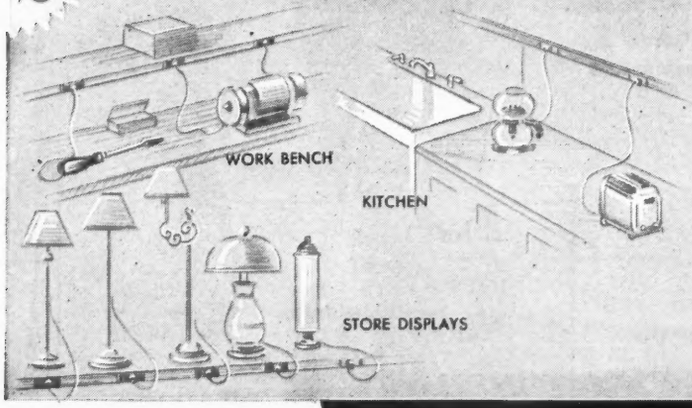
1 A FLUORESCENT LIGHTING SYSTEM


INDUSTRIAL LIGHTING FEEDER
SHOW CASE OR WALL CASE
COMBINATION LIGHTING AND OUTLET STRIP
INDIVIDUAL OR MULTIPLE UNITS

- Sell it as a *combined* feeder raceway, and suspension for lighting fixtures *plus* the economy and convenience of plug-in connections to units.
- Sell it to span beams in factory and commercial buildings.
- Sell it as a show case, wall case or special purpose fluorescent lighting strip with or without reflectors.
- Sell it as a combined outlet and lighting strip in kitchens etc.

ASK FOR DATA SHEET

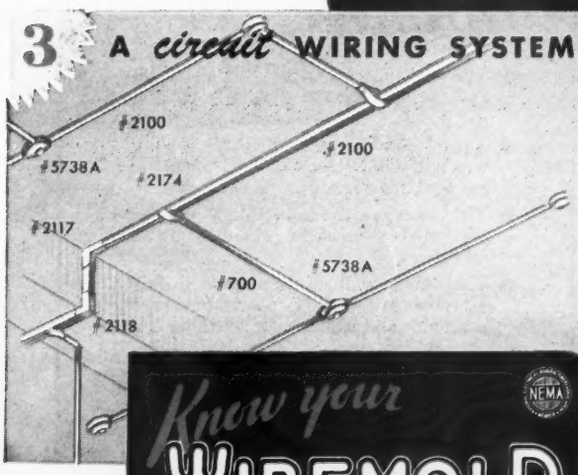
2 A PLUG-IN-ANYWHERE *convenience* WIRING SYSTEM



- Sell it for plug-in-anywhere convenience in homes, offices, schools, hospitals, hotels etc. . .
- *"All* the outlets desired *exactly* where they're *needed"*.
- Sell it to industries for work benches, laboratories, test racks, etc. . .
- Sell it to department stores for display areas.
- Sell it to architects, builders, housewives . . . the highest expression of ADEQUATE WIRING.

ASK FOR DATA SHEET

3 A *circuit* WIRING SYSTEM



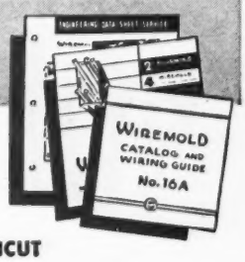
- SELL it to building management and to industry as an ideal "mid-size" circuit wiring channel.
- Interconnects with all other Wiremold Systems and with existing wires.
- Listed by U. L. with all necessary fittings for complete installation.
- Conveniently and economically Spans Beams.
- Hanger fittings 2108 A and 2108 D meet all needs.

ASK FOR DATA SHEET

Know your WIREMOLD

NEMA

.... MORE THAN ADEQUATE WIRING



Wiremold Engineering Data Sheets and other literature are designed to help solve wiring problems. If you are not receiving this literature, send us your name TODAY.

THE WIREMOLD COMPANY • HARTFORD 10, CONNECTICUT

IT COSTS LESS

to Install

ROCKBESTOS

WIRES, CABLES & CORDS

Because They Last

A low cost per foot may seem economical when buying wire and cable, but it's the cost *per year of operation* that tells whether you bought a bargain or a maintenance-booster.

That's why wire-wise buyers specify Rockbestos A. V. C. for trouble-making circuits. They know that it gives *extra* years of service and far outlasts other types in 230°F. operating temperatures—that it withstands heating and cooling cycles in conduit—that it won't rot or bloom when exposed to corrosive fumes, grease or oil—and that it doesn't require expensive maintenance.

Service records on hot-spot circuits will show up your hidden costs. Trial installations will convince you that Rockbestos A. V. C. saves money. Select your requirements from our catalog which shows Rockbestos-developed National Electrical Code types and many others in 300 to 5000 volt ratings.

ROCKBESTOS PRODUCTS CORPORATION
183 NICOLL ST., NEW HAVEN 4, CONN.

This Type AVA Rockbestos A. V. C. 600 Volt Power Cable and similar types rated up to 5000 volts give trouble-free performance under 230° F. operating temperatures and other severe conditions because:

- The impregnated asbestos braid is resistant to heat, corrosive fumes, moisture, oil, grease and flame.
- The felted asbestos wall beneath the braid won't dry out, crack or flow under high ambient temperatures.
- The moisture resistant high dielectric varnished cambric is protected by two asbestos walls.
- The inner wall of impregnated felted asbestos withstands conductor-heating overloads and won't bake brittle or burn.

One of 125 different wires and cables designed by Rockbestos to meet severe or unusual operating conditions.

ROCKBESTOS A.V.C.

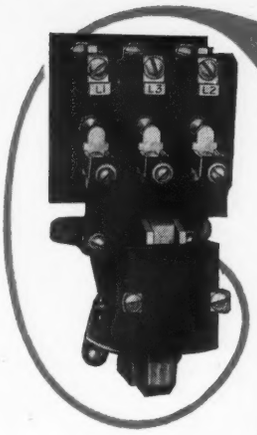
The Wire with Permanent Insulation

NEW YORK BUFFALO CLEVELAND PITTSBURGH
DETROIT CHICAGO ST. LOUIS LOS ANGELES
SAN FRANCISCO SEATTLE PORTLAND, ORE.

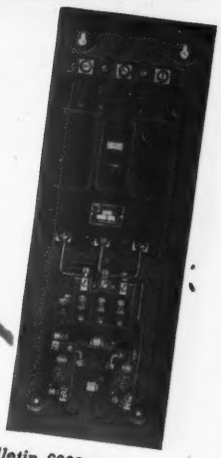
ALL THESE STARTERS ARE BUILT AROUND "3C" Bulletin 7700 A. C. MAGNETIC CONTACTORS

These small, compact, sturdy Contactors are the backbone of all magnetic motor starters pictured here—Sizes 0 and 1—15 and 25 amperes.

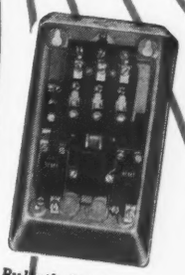
Think what this means to the user of these starters—Less spare parts—and unifomity of design.



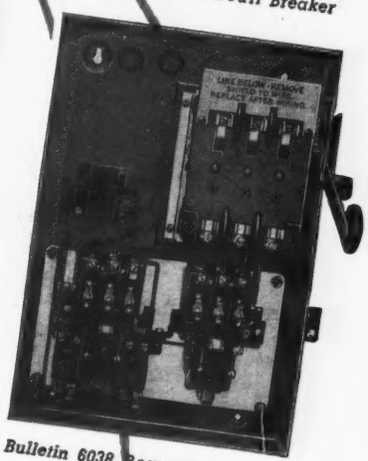
Bulletin 7727 A. C. Contactor



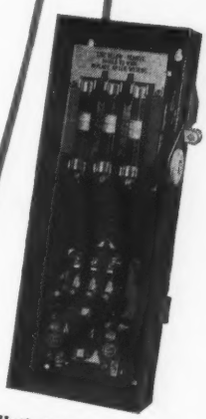
Bulletin 6020 Non-Reversing Combination Starter with Air-Circuit Breaker



Bulletin 6013 Non-Reversing Starter



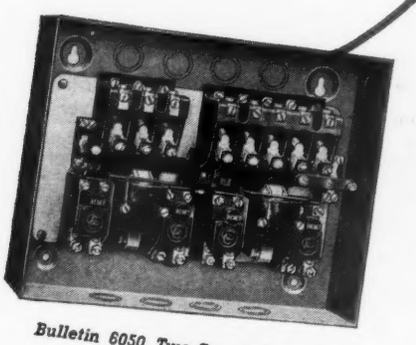
Bulletin 6038 Reversing Combination Flexible Starter



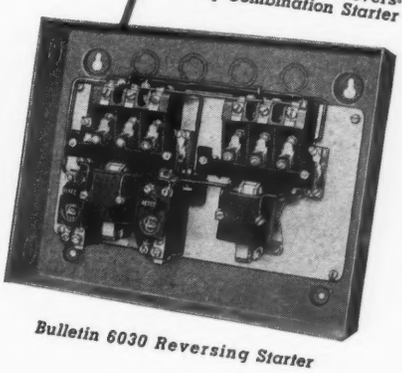
Bulletin 6018 Non-Reversing Combination Starter

FEATURES

- Hinged armature, vertical lift magnet
- Short armature travel—minimum impact
- No sliding or wearing parts
- Double Break Silver to Silver Contacts
- All terminals front accessible
- Plenty of wiring space
- Cabinet knockouts . . . Top, Bottom, Sides, Back



Bulletin 6050 Two-Speed Starter



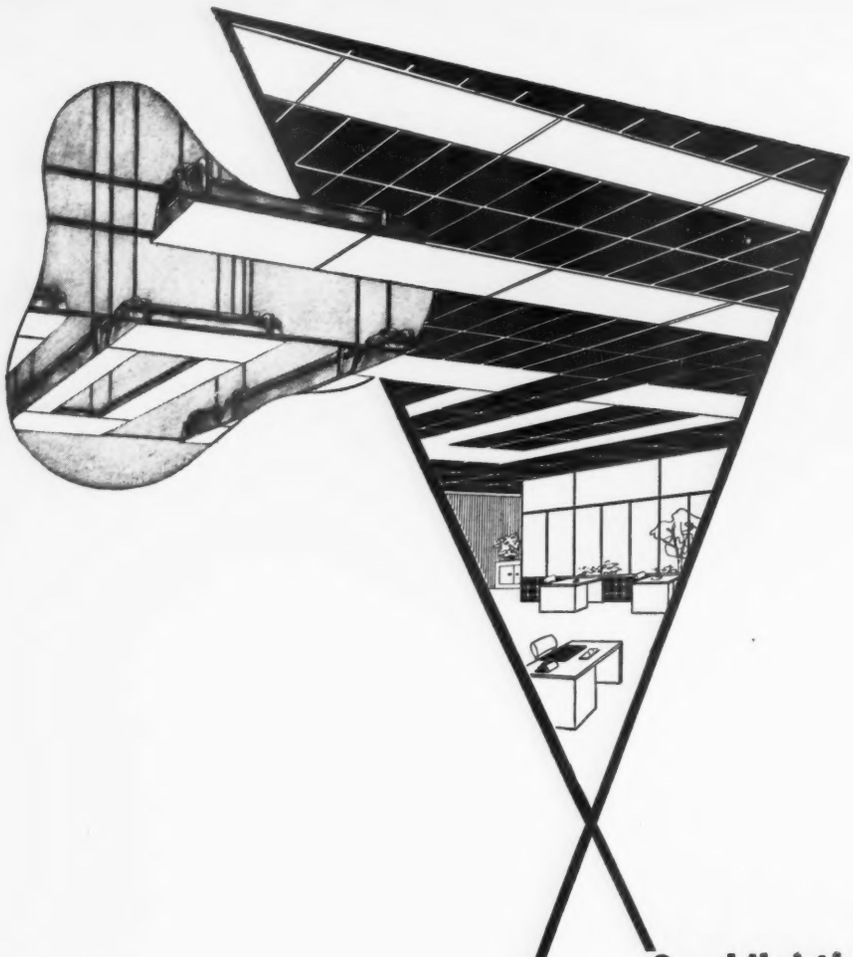
Bulletin 6030 Reversing Starter

Bulletin 6040 Reversing Combination Starter

Get these dependable starters from your nearest "3C" Distributor.

THE CLARK CONTROLLER CO.

EVERYTHING UNDER CONTROL • 1146 EAST 152nd STREET, CLEVELAND 10, OHIO



Good lighting, plus ceilings unlimited ..one lighting system gives you both

CEILINGS UNLIMITED — a boundless new field for the use of light as a structural aid in interior design is the added benefit offered stores, offices, schools, factories and public buildings through the installation of MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS.

THE MILLER CEILING FURRING HANGER (patented) — which supports structural ceiling and TROFFER lighting system — simplifies installation and makes possible a versatility of lighting applications to form any ceiling pattern desired — CEILINGS UNLIMITED.

More! Installation is simplified. Less than half usual number of supports needed from structural ceiling. Wiring costs cut up to 50%, and conduit and conduit fitting costs up to 80%.

Miller Lighting service is all-inclusive. Its 50 and 100 FOOT CANDLERS (Continuous Wireway Fluorescent Lighting Systems) have been established as standard for general factory lighting. And its Incandescent and Mercury Vapor reflector equipment have broad factory and commercial application.

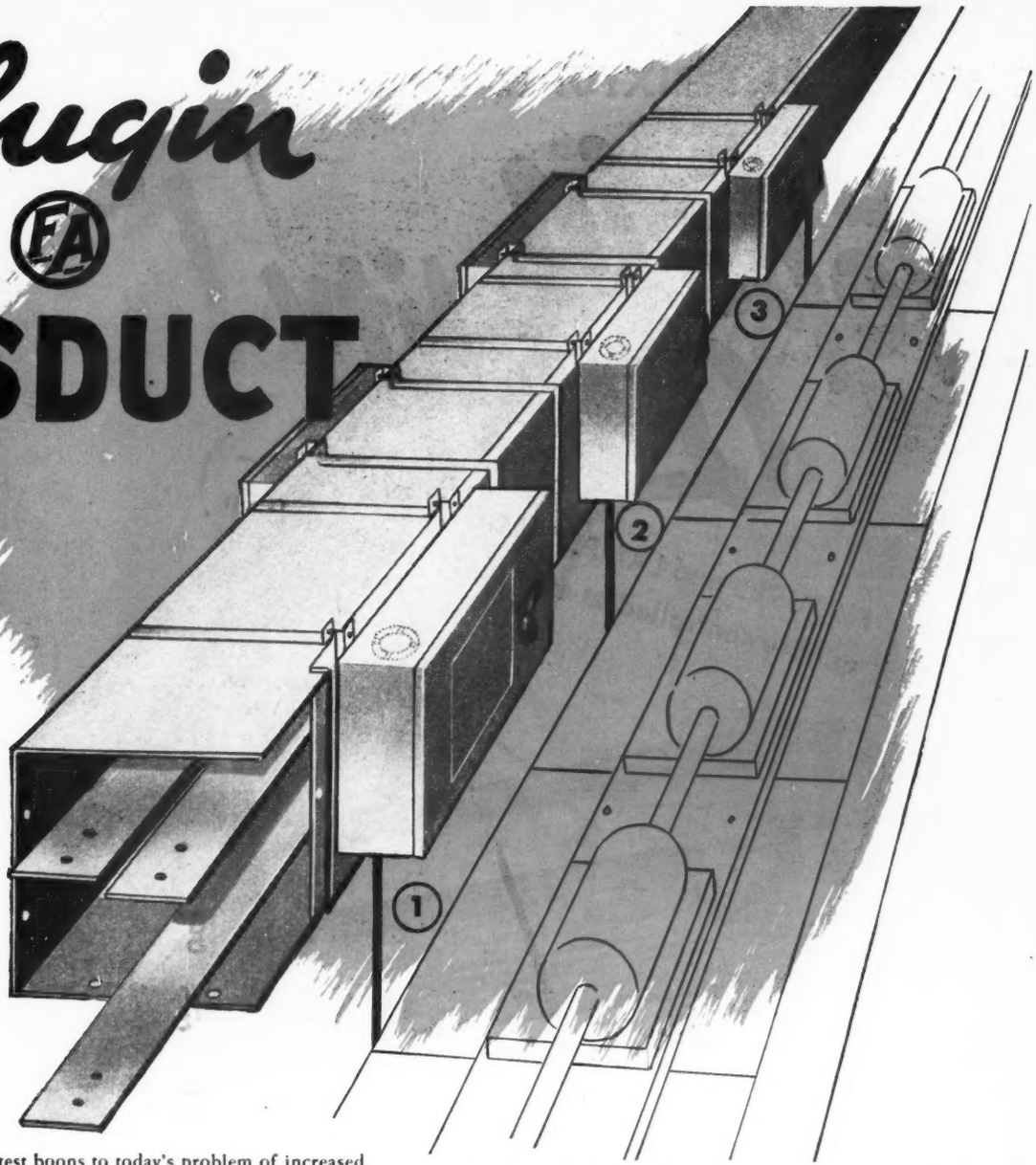
MILLER field engineers and distributors, conveniently located, are at your call.

THE MILLER COMPANY

ILLUMINATING DIVISION, MERIDEN, CONNECTICUT

ILLUMINATING DIVISION: Fluorescent, Incandescent, Mercury Lighting Equipment. HEATING PRODUCTS DIVISION: Domestic Oil Burners and Liquid Fuel Devices. ROLLING MILL DIVISION: Phosphor Bronze and Brass in Sheets, Strips and Rolls.

Plugin FA BUSDUCT



. . . "One of the greatest boons to today's problem of increased production!" . . .

That is what users say of PLUGIN FA BUSDUCT — the modern, convenient, economical and flexible system of power and light distribution.

PLUGIN FA BUSDUCT helps speed production by saving thousands of man hours each year, reducing waste motion and lost time by making power available where and when you want it. Plugin outlets every foot of the way make it possible to move and relocate machinery at will and eliminate long and expensive lead-ins with a consequent drop in voltage.

If you want to speed up and increase the productivity of your plant, then install PLUGIN FA BUSDUCT—and see the difference.

PLUGIN FA BUSDUCT is available in standard ten-foot sections with multiple outlets for any of the following attractively finished, practical plugin units:

1. **SHUTLBRAK** — Ideal for quick make and break, heavy-duty operation. Capacities: 30 to 200 amps. — 250 and 575 volts.
2. **KLAMPSWITCHFUZ** — Splendid for disconnect service . . . the hinged-type pull out door containing both switch and fuse in one unit. Capacities: 30 to 200 amps. — 250 and 575 volts.
3. **CIRCUIT BREAKER** — Provides automatic-thermal overload protection for circuits and equipment. Capacities: 15 to 225 amps. — 250 and 575 volts.

The Most Economical Path from Power Source to Equipment

MAKERS OF . . .
BUSDUCT
PANELBOARDS
SWITCHBOARDS

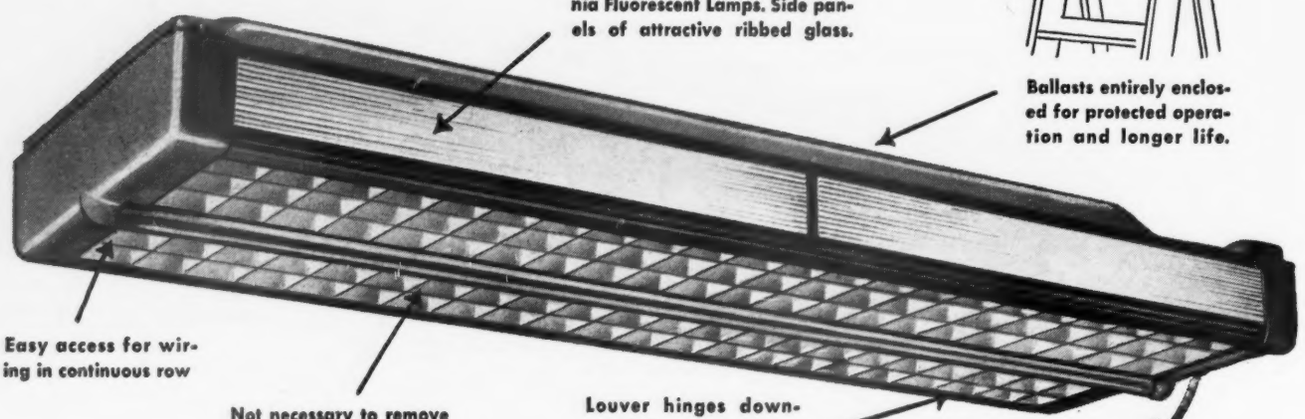
Frank Adam
ELECTRIC COMPANY
ST. LOUIS, MISSOURI

SERVICE EQUIPMENT
SAFETY SWITCHES
LOAD CENTERS
ELECTRIC QUIKHETER

YOU'LL WANT TO HANDLE THE FLUORESCENT FIXTURES THAT ARE

Tops in Quality!

(FIXTURES and LAMPS MADE BY SYLVANIA—quality controlled at every stage of production)


Complete with 4 40-watt Sylvania Fluorescent Lamps. Side panels of attractive ribbed glass.
Ballasts entirely enclosed for protected operation and longer life.
Easy access for wiring in continuous row
Not necessary to remove a single nut or screw to change starters or lamps.
Louver hinges downward for easy cleaning of louver and lamps.

TYPICAL of the complete Sylvania line of commercial fluorescent fixtures is the beautiful, modern, louvered CL-440 shown above. This model—as with all Sylvania fixtures—is *completely* guaranteed, assuring your customers the tops in engineering and quality. The CL-440 is ideal for stores; public buildings, offices.

Here you find styling that sells itself—and most important—ease of installation and maintenance that means quicker, simplified servicing *at a greater profit to you!* There's a quality Sylvania fixture for every commercial need—each carefully designed to be the easiest to install . . . simplest to maintain! *Sylvania Electric Products Inc., Salem, Mass.*

REMEMBER ALL LAMPS IN SYLVANIA FIXTURES ARE SYLVANIA-MADE... THEREFORE OF THE HIGHEST QUALITY
These lamps have rugged qualities, brilliance and many refinements that far surpass demands of your most critical customers.

SYLVANIA ELECTRIC

"Fluorescent at its Finest!"

FOR STORE, FACTORY, OFFICE, HOME

WITH

TRUMBULL (T) ELECTRIC

PANELBOARDS

For reasons of Safety, Appearance and minimum Space Occupancy, Trumbull recommends modern Column Type Panelboards which fit neatly within the web of an "H" beam in factory buildings.

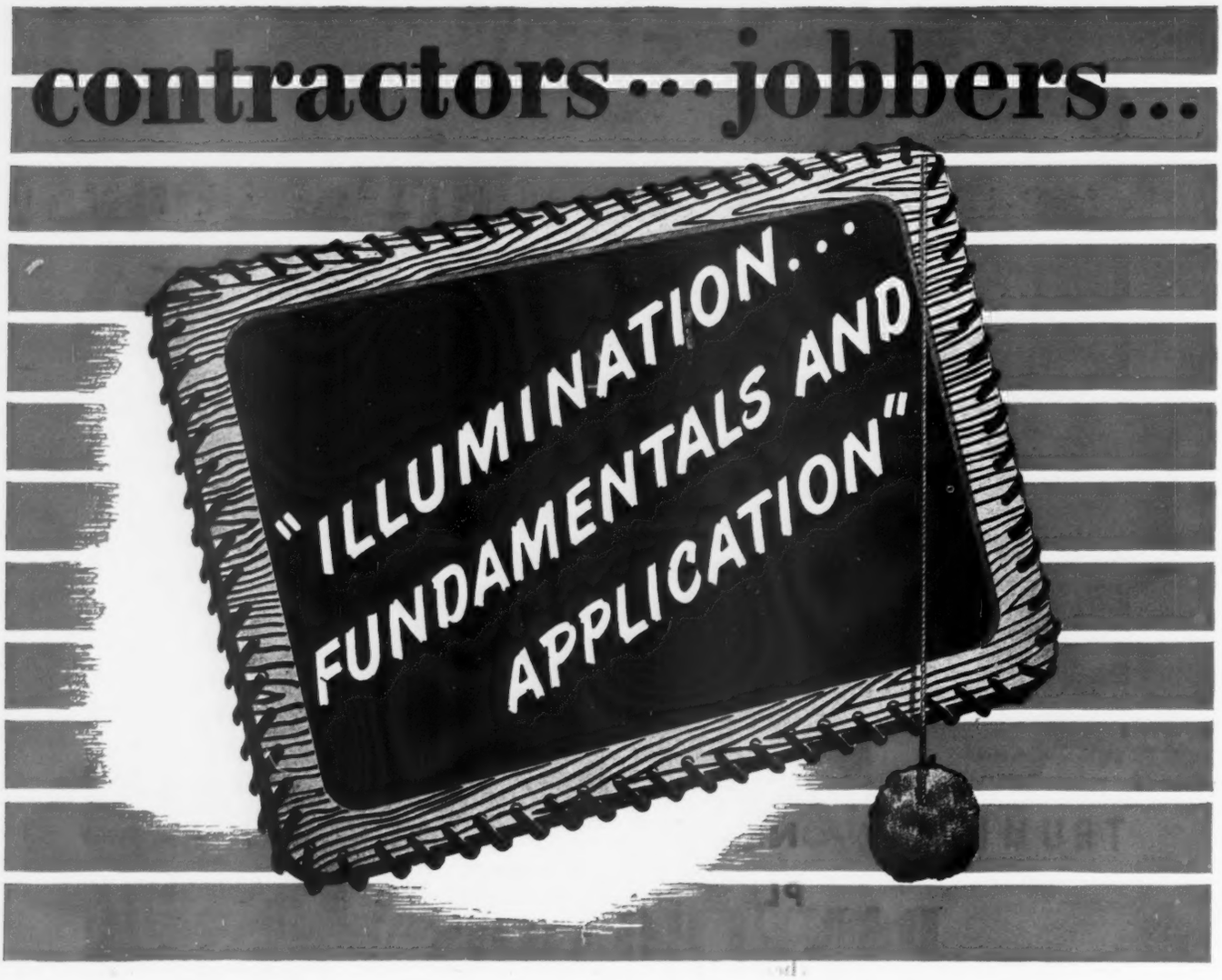
The narrow type cabinet is installed at the conventional height with its extension trough carried up the beam nearly to the ceiling. At that point a pull-box is installed, making it unnecessary to carry long main and branch circuit conduit runs to the panel . . . an advantage in wiring time, material costs, and neatness.

For lighting and/or appliance branch circuit protection, Trumbull has standardized Column Type Panels to fit both 8" and 10" beams. Type M Multibreaker units provide for a maximum of 42 single pole or 20 double pole branch circuits, ranging from 15 to 50 amperes.

"On the Beam" with Trumbull Column Type is *good* Panelboard installation.

THE TRUMBULL ELECTRIC MANUFACTURING CO.
PLAINVILLE, CONNECTICUT
OTHER FACTORIES AT NORWOOD, OHIO • LOS ANGELES • SAN FRANCISCO • SEATTLE

contractors...jobbers...



ALREADY BEING USED ENTHUSIASTICALLY BY UTILITIES ALL OVER THE COUNTRY

MICHIGAN

"We feel that it is one of the finest contributions to the problem of training that has yet been produced."

ALABAMA

" . . . your eighteen Sound-Slide Film lessons . . . proved to be an excellent course and the praise from our salesmen, both old and new, was instantaneous and constant."

PENNSYLVANIA

" . . . former employees for whom the course was a 'refresher' . . . remarked how well it screened the wide field of current lighting data to emphasize the essential points and bring them up to date quickly . . . The new men found the 'Fundamentals' a logical introduction into a branch of engineering with which they were unacquainted, and they made surprisingly rapid progress."

CALIFORNIA

" . . . this is the best approach to the lighting training problem I have had the privilege of seeing to date, and I recommend your course very highly to anyone faced with the problem of training a lighting sales staff."

OHIO

"We have used the Westinghouse Lighting Course and not only find it extremely valuable as a basis for training some of our inexperienced Lighting Engineers but found it very well received by our Lighting Engineers who have had many years experience in the Lighting field. We recommend this course very highly."

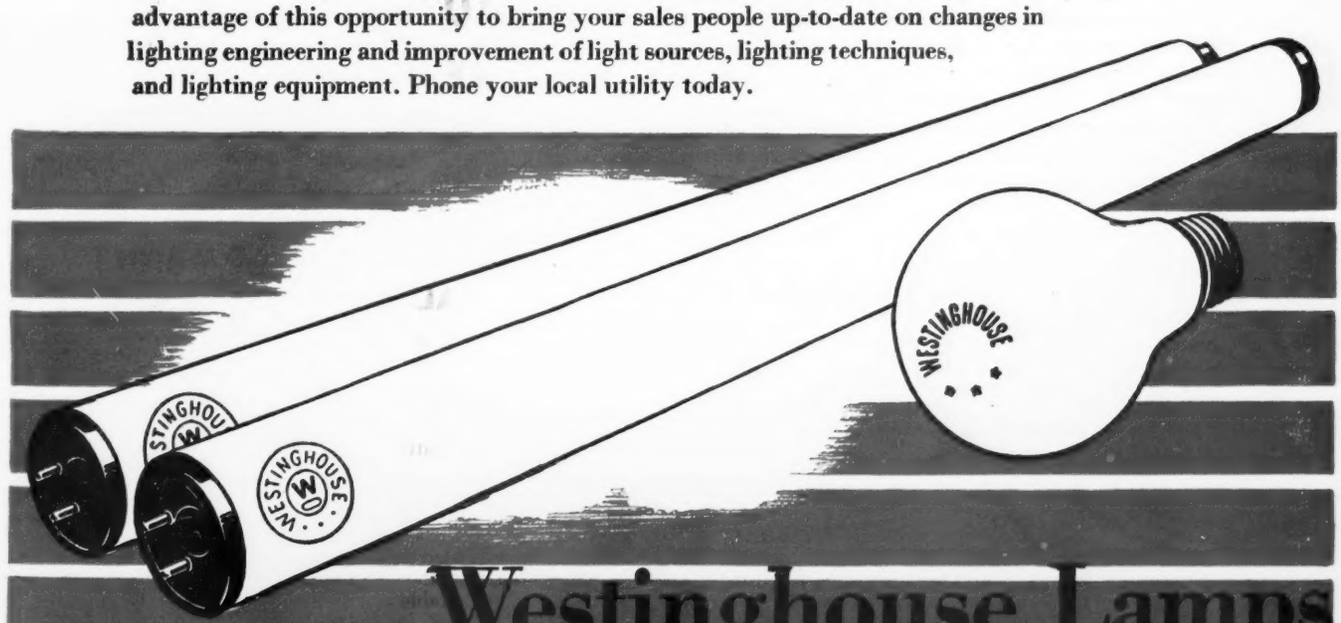
...plan now to enroll your sales people in this LIGHTING COURSE

Here is the most comprehensive lighting course ever prepared. It is complete and authoritative. It consists of 18 sound-slide films patterned after those used so effectively for training purposes by the armed services. The list of subjects follows:

1. The Mechanism of the Human Eye
2. Light and Vision
3. Illumination Terminology
4. Quantity Requirements of Good Illumination
5. Quality Requirements of Good Illumination
6. Importance of Color in Illumination
7. The Incandescent Lamp
8. Electric Discharge Lamps
9. The Fluorescent Lamp
10. Principles of Light Control
11. Systems of Light Control
12. Calculation of Interior Illumination
13. Office Lighting
14. School Lighting
15. Store Lighting
16. Industrial Lighting
17. Floodlighting
18. Cost and Maintenance of Lighting

PHONE YOUR LOCAL UTILITY TODAY FOR ITS PLAN FOR GIVING THIS COURSE

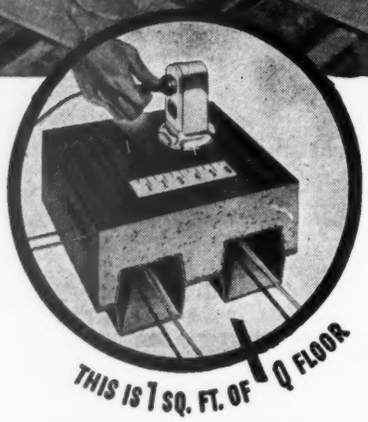
Your local utility company is headquarters for this Westinghouse training course. Phone today for the details of its plan for giving the course to contractors and jobbers in your area. Take advantage of this opportunity to bring your sales people up-to-date on changes in lighting engineering and improvement of light sources, lighting techniques, and lighting equipment. Phone your local utility today.



Westinghouse Lamps

FOR EVERY LIGHTING REQUIREMENT

ELECTRICAL CHANGE is as much a part of the Building as the Q-Floor



The urge for tenants to call an electrician is built-in. Those triple raceways are installed right on the floor. Connecting with each steel cell, they make it possible to wire an electrical outlet on every exposed six-inch area of the entire floor. The emphasis is on the use of electricity.

The convenience persuades tenants to want lots of outlets and to want them where and when they want them! That calls for constant electrical work.

Q-Floor has been approved and listed by Underwriters' Laboratories, Inc., in accordance with article 356 of the National Electrical Code and is adaptable to any type of wiring.

Even though Q-Floors do stimulate more electrical work over the years, building owners are sold on the idea that this is more than paid for by the higher rents a Q-Floor building can command over the years.

H. H. ROBERTSON COMPANY

2400 Farmers Bank Building Pittsburgh 22, Pennsylvania

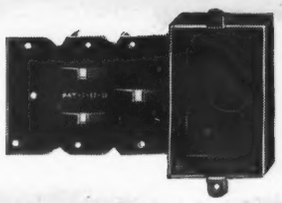
Offices in 50 Principal Cities World-Wide Building Service

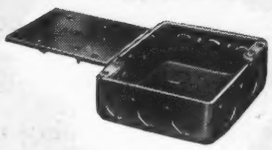
Electrical Fittings for use with Robertson Q-Floors can be obtained from General Electric Construction Materials distributors. See the nearest G. E. merchandise distributor for information on how Q-Floor fittings can be used to attain up-to-the-minute electrical wiring.

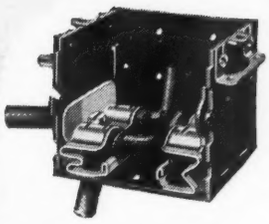
Q-FLOORS AND ELECTRICIANS ARE PARTNERS in the business of keeping buildings young

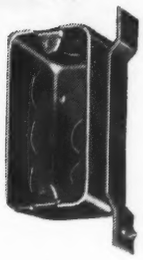
You Can Always Rely on RACO!

RACO—
Switch Boxes
Outlet Boxes





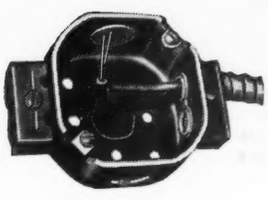




• Architects, builders and electrical contractors the country over know that they "Can Always Rely on Raco." They know that 34 years' engineering experience backs up this quality line.

Get acquainted today with Raco All-Steel Products. You, too, will find that it's the *dependable* line, the *uniform* line, the *clean* line—no ragged or rough edges; attractively finished and packed in cartons.

Remember our slogan—it's *your* assurance of a better line of steel switch and outlet boxes!



★ ***Many other types also available*** — **A BOX FOR EVERY NEED**

ALL-STEEL EQUIPMENT, INC.
600 Kensington Avenue
Aurora, Illinois

RACO
ALL-STEEL PRODUCTS

A Complete Line of Switch and Outlet Boxes

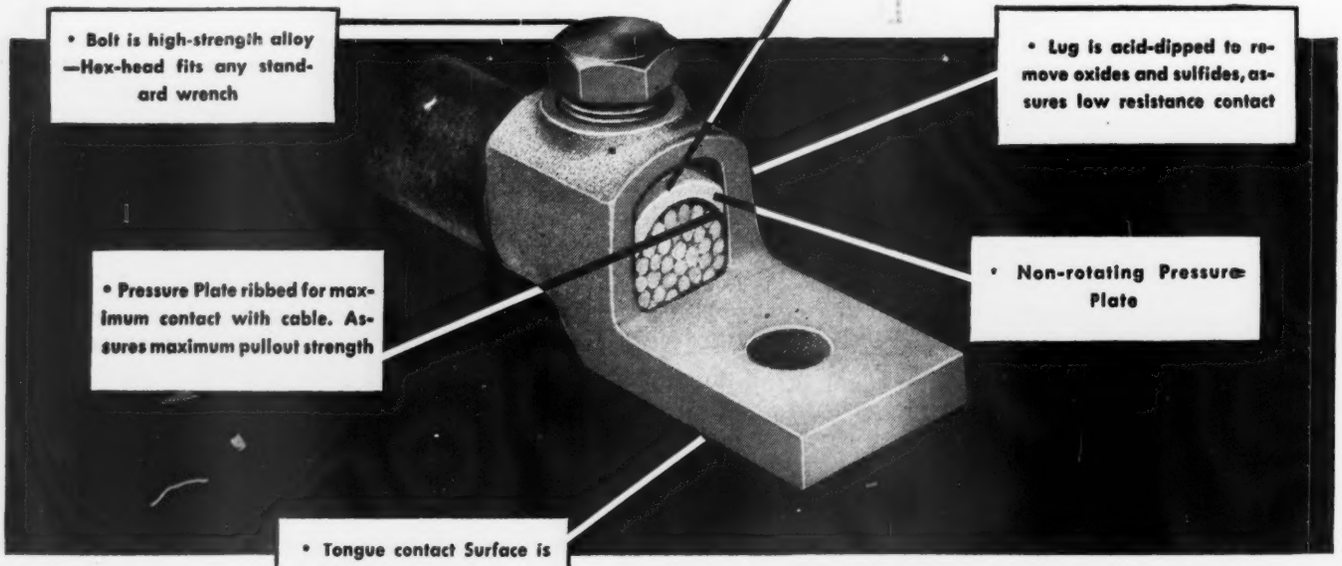
ALL-STEEL EQUIPMENT, INC.

No more loose connections!

O.Z. has this spring steel lock washer here

Only O. Z. has a tin plated Spring Steel Lock Washer in a solderless connector lug! Only O. Z. Connector Lugs can give you such positive insurance against the hazards of loose connections! Superior to washers of "special" alloys, the O. Z. Spring Steel Lock Washer holds its resiliency, exerts greater locking pressure and *maintains* that pressure. Once tight, always tight—if it's O. Z.

O. Z. Solderless Connectors set a standard of superior design. Check these *Additional* Features!


• Bolt is high-strength alloy —Hex-head fits any standard wrench
• Lug is acid-dipped to remove oxides and sulfides, assures low resistance contact
• Pressure Plate ribbed for maximum contact with cable. Assures maximum pullout strength
• Non-rotating Pressure Plate
• Tongue contact Surface is machined for better, low resistance connection

2707

"They're O. K. if they're O. Z."

CONDUIT FITTINGS • CABLE TERMINATORS
CAST IRON BOXES • SOLDERLESS CONNECTORS
GROUNDING DEVICES • POWER CONNECTORS

O.Z. ELECTRICAL MANUFACTURING COMPANY
262 BOND STREET · BROOKLYN, 2 N. Y.

This fixture is

AVAILABLE NOW

Suave and smart, suitable for any interior, home, office or shop. Always in good taste, this fluorescent fixture opens up a variety of new opportunities where it fills immediate needs.

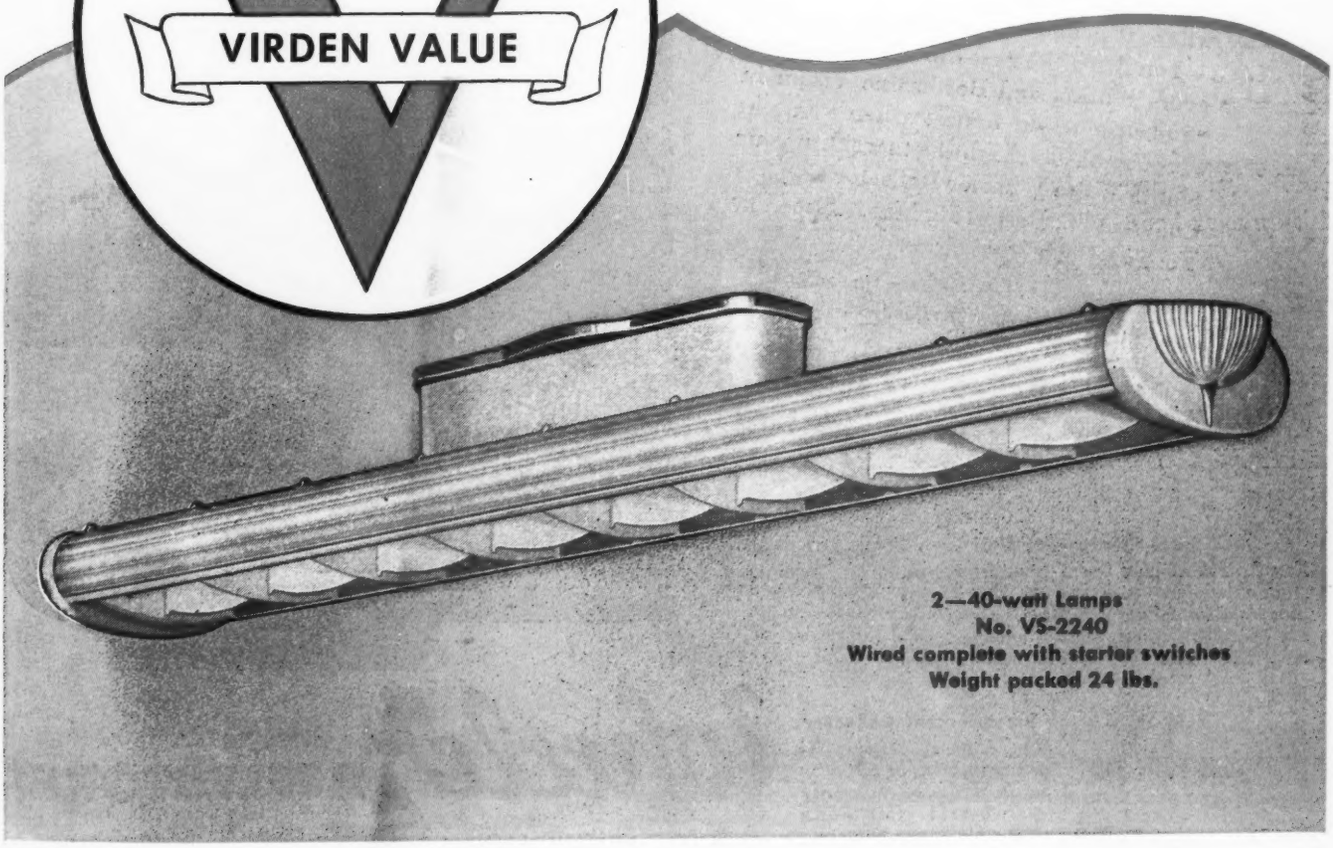
Departing from old techniques it introduces new technique in construction, material and design.

Light in weight, it does not sacrifice a single element of strength. Engineered for greatest efficiency, no light is trapped or wasted. A product of advanced concepts in the use of plastics, all important plastic lines are *lines of light.* Ingenious shielding, which never has to be removed for replacing lamps, contributes to light volume and gives broad distribution of a beautiful quality of light.

Other features deserving attention

Approved by Underwriters • Power factor corrected
Easy to relamp
Beautifully finished with Hibake enamel for high reflection factor
Modestly decorated with polished chromium.

Your Virden distributor can supply you promptly



2—40-watt Lamps
No. VS-2240
Wired complete with starter switches
Weight packed 24 lbs.

John C. Virden Company • Cleveland, Ohio

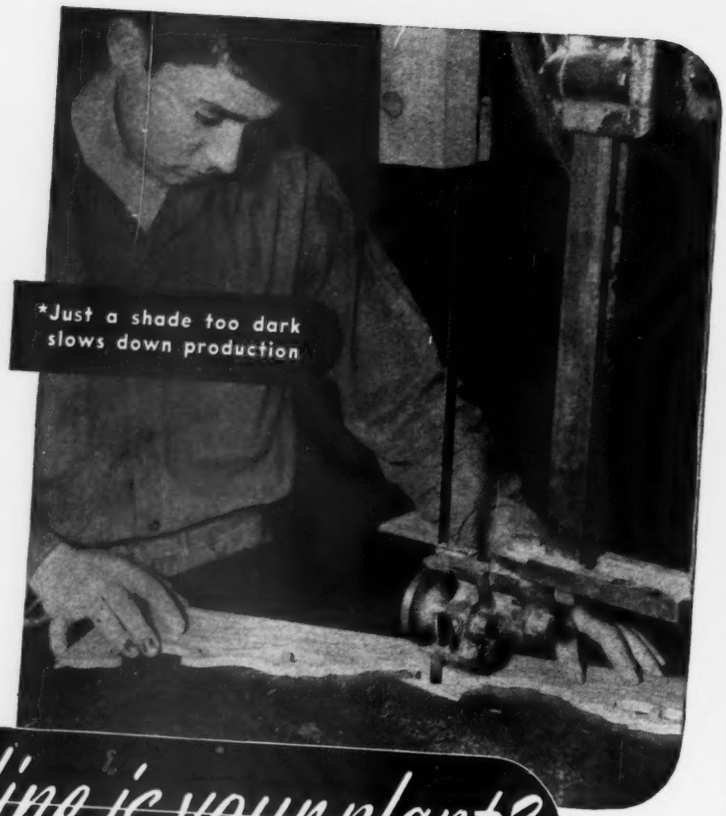
Member of Home Lighting Institute

Borderline Vision*

may be shading your profits!

● GOOD LIGHTING today is an important production tool. But the difference between good lighting and Borderline Vision—lighting that's just a shade too dim—is often hard to see at a glance.

The best lighting today is a carefully engineered product—engineered to pay you dividends in increased, *better* work—better employee morale—and decreased costs. Wheeler engineers have been paying these dividends to manufacturers through Wheeler Skilled Lighting ever since 1881. Wheeler Reflectors give maximum illumination from standard

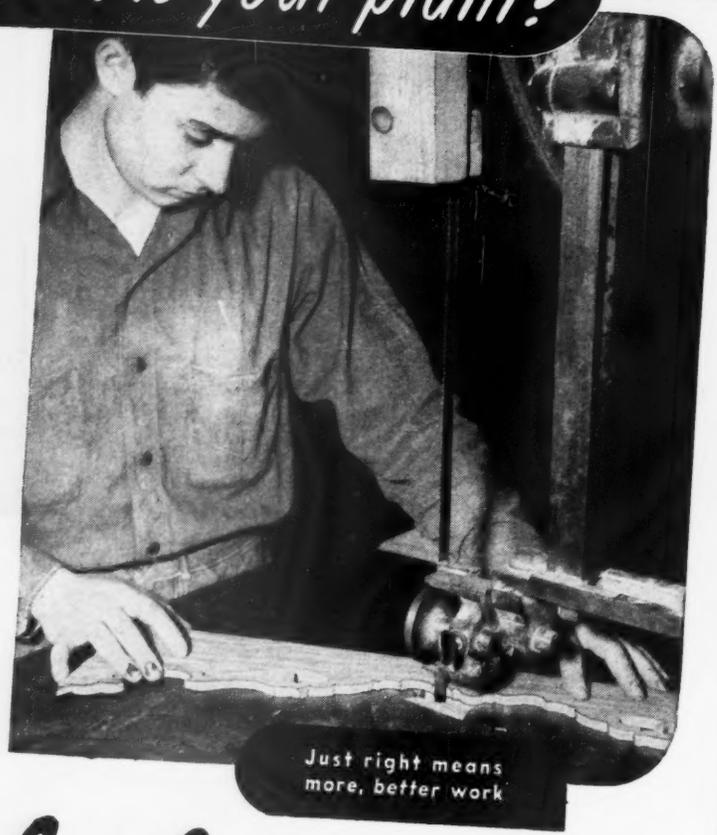


Which side of the line is your plant?

lamps because they *control* light. Their high reflection factor puts light to work where it belongs—on the job.

You'll see the real difference between good lighting and Borderline Vision in your production figures when you put Wheeler Skilled Lighting to work in your plant. Write Wheeler Reflector Co., 275 Congress St., Boston 10, Mass. Also New York and principal cities.

Distributed Exclusively Through Electrical Wholesalers



All-Steel Fluorescent Unit
For 2 or 3 40-watt, or 2 100-watt lamps. Available with open end or closed end porcelain enameled reflectors. Broad wiring channel with accessible enclosed ballast. For individual or continuous runs.

RLM Solid Neck Incandescent Reflector

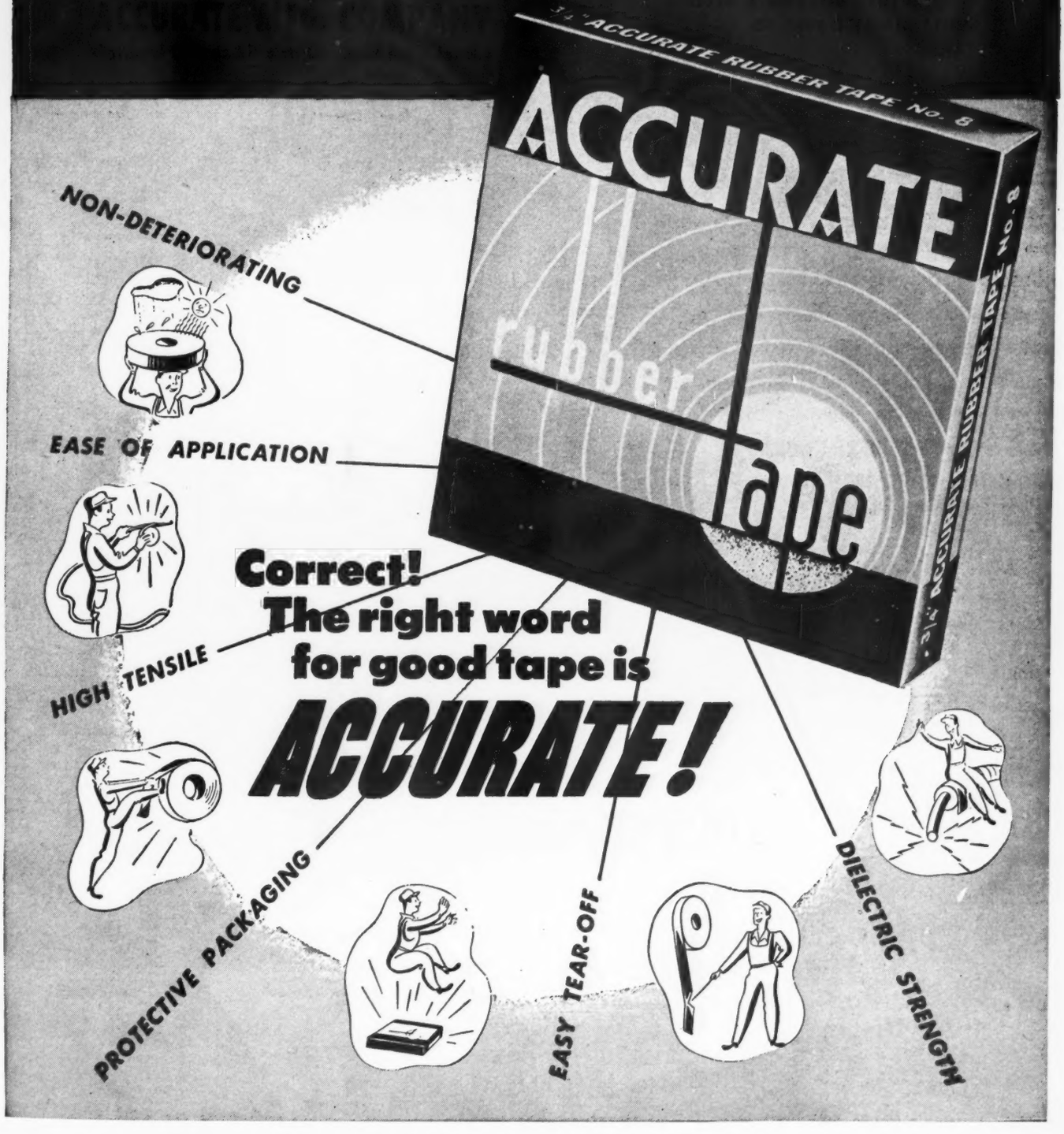
Maximum lighting efficiency indoors or out. Expertly designed, ruggedly built. Vitreous enamel only, 75 to 1500 watts.

Wheeler REFLECTORS

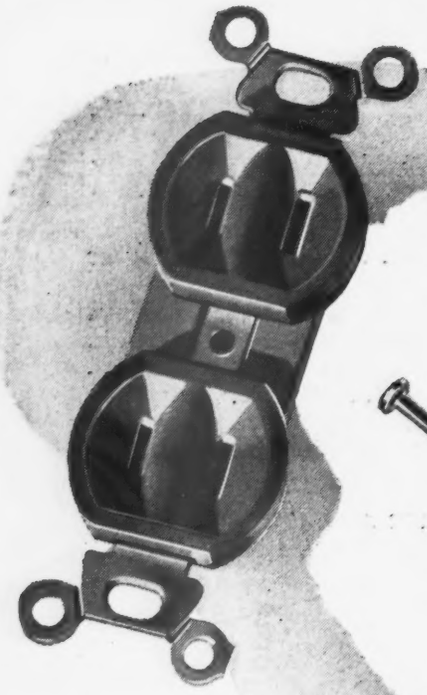
SKILLED LIGHTING

MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881

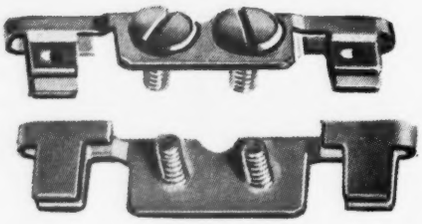
IT'S ACCURATE!



new... duplex outlet meets FEDERAL SPECIFICATIONS!

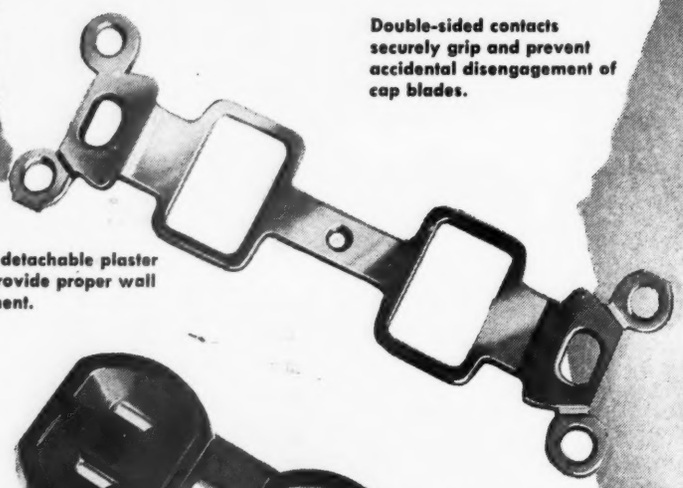


Large readily accessible binding screws will accommodate No. 10 wire.



The new Bryant No. 6122 Duplex Convenience Outlet is designed for residential installations—heavy all-molded Bakelite construction, double-sided contacts to grip cap blades securely and plaster ears to assure proper alignment. Large binding screws and a small, compact cup provide easy wiring and quick installation. Available in brown or ivory.

Double-sided contacts securely grip and prevent accidental disengagement of cap blades.



Easily detachable plaster ears provide proper wall alignment.

Finding slots speed cap insertion.

Yoke is firmly anchored in Bakelite housing.

BRYANT
SUPERIOR WIRING DEVICES

THE BRYANT ELECTRIC COMPANY

BRIDGEPORT 2, CONNECTICUT

NEW YORK • CHICAGO • LOS ANGELES

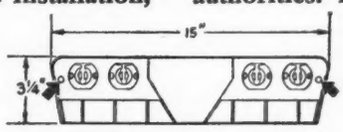
J-99800

Firefly Super Hi-Lite installation in office of Clark Supply Company, 1330 W. Clybourn St., Milwaukee—Distributors of electrical equipment and air-conditioning units.

FIREFLY *Super* HI-LITE

SAVES TIME AND MONEY
. . . SIMPLE, ONE-MAN INSTALLATION

Ceiling-mounted Super Hi-Lites provide the advantage of "troffer" lighting with greater ease and economy of installation . . . a simple, one-man job. Each unit slips easily into a unique Z-type mount with a single motion. The fixtures are fastened together by two tie-in end bolts, instead of the usual one-bolt connection, giving extra strength and rigidity to the installation, making it easy to get perfect alignment of the fixtures as well as follow the natural contour of the ceiling. The simplicity of Firefly Super Hi-Lite ceiling mounting makes it easy to figure accurate installation costs . . . whether in single units, diagonal mounting or continuous rows.



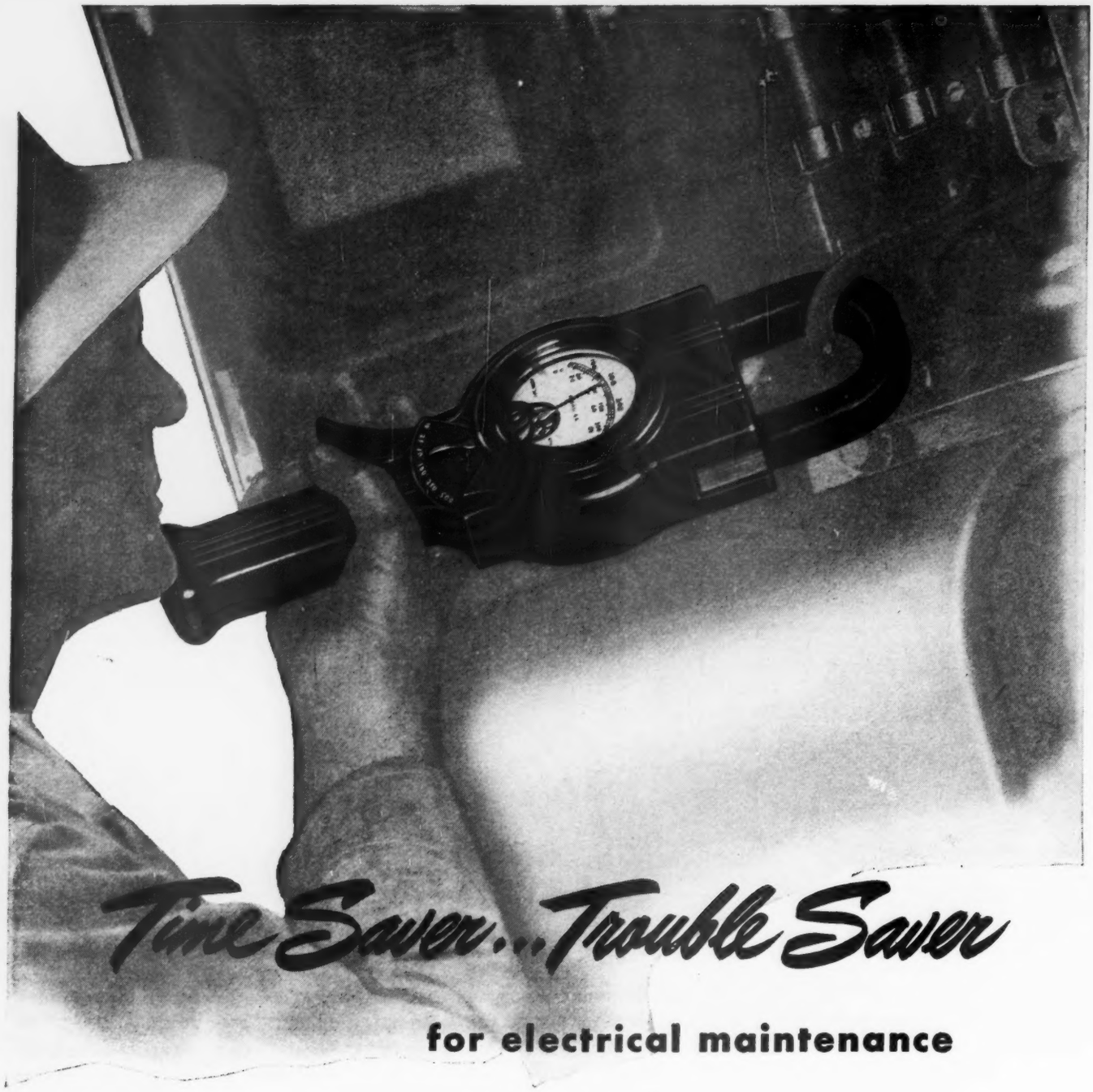
Showing holes for tie-in end bolts. Lamps slip in easily from top.

The Firefly Super Hi-Lite is an unusually slim horizontal-type 4-light unit, only 3¼" deep. The scientific spacing of the bottom louvers gives the 45° angle cut-off from line of vision recommended by lighting authorities. The Super Hi-Lite is remarkably flexible. The quick-removable louvers may be added later to bare tube installations if desired. New Corning Alba-lite glass side panels are practically integral with louvers. Entire unit easy to keep clean.

The Super Hi-Lite is Underwriters Approved . . . union made, finished in quality double-baked, heat-resisting white enamel. Mountable from pendants or direct to ceiling. *Distributed exclusively through leading electrical wholesalers.* Write for literature.

KAHN MANUFACTURING CO., INC.
2051 N. 19th STREET • MILWAUKEE 5, WISCONSIN.

THE *Firefly Line* OF FINER FLUORESCENT FIXTURES



Time Saver...Trouble Saver

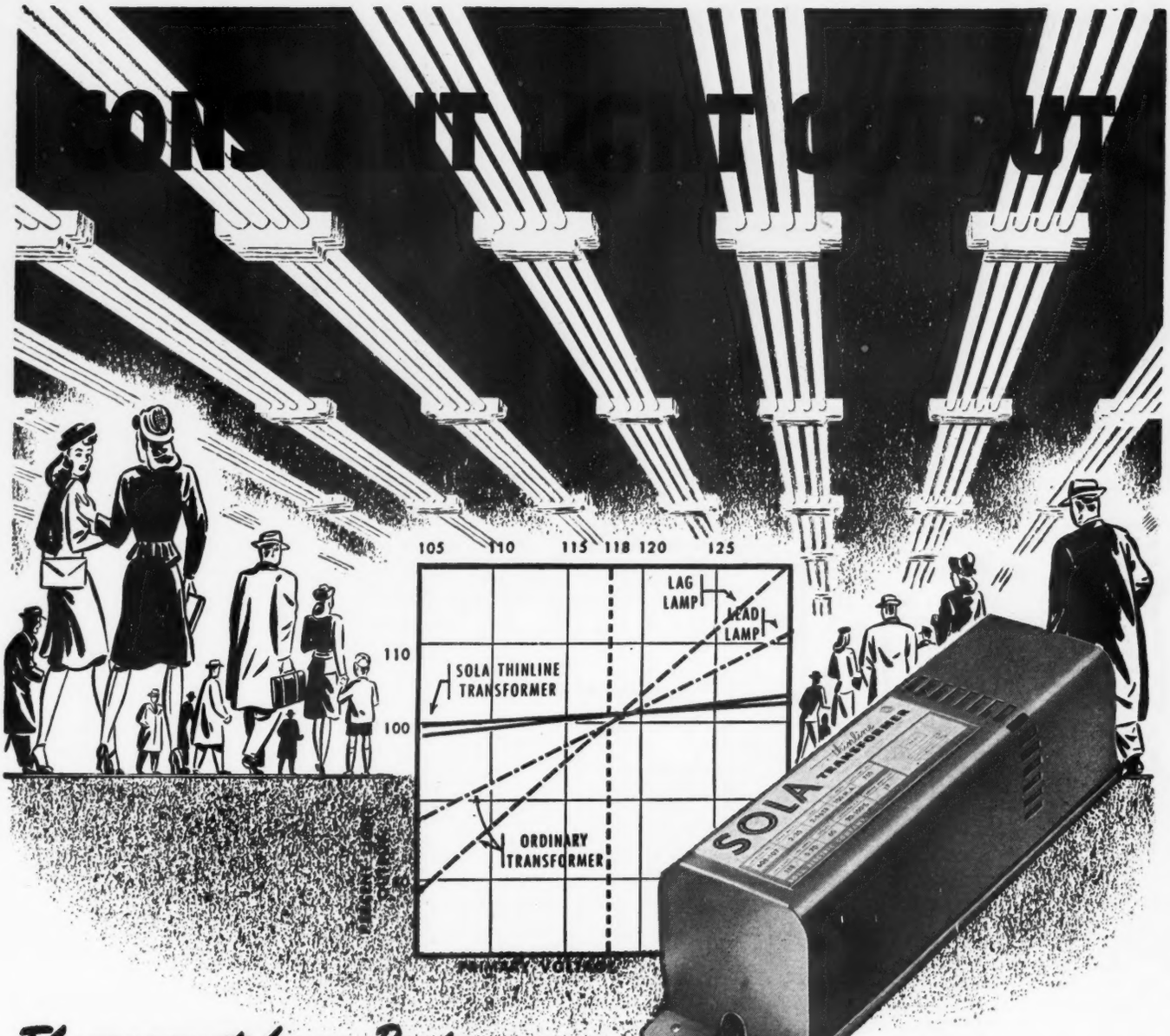
for electrical maintenance

WESTON AC CLAMP-AMMETERS

A time saver for either routine checks or trouble shooting. The jaws are simply hooked around the conductor and reading made without interrupting circuits or disrupting work. Three types available . . . top ranges of 500, 1000, or 2000 amperes. For further information see your local WESTON representative, or write . . . Weston Electrical Instrument Corporation, 672 Frelinghuysen Avenue, Newark 5, New Jersey.

Weston *Instruments*

ALBANY • ATLANTA • BOSTON • BUFFALO • CHARLOTTE • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN • MINNEAPOLIS • NEWARK
NEW ORLEANS • NEW YORK • PHILADELPHIA • PHOENIX • PITTSBURGH • ROCHESTER • SAN FRANCISCO • SEATTLE • ST. LOUIS • SYRACUSE • IN CANADA, NORTHERN ELECTRIC CO., LTD., POWERLITE DEVICES, LTD.



Fluorescent Lamp Performance is only as good as its source of power . . . the TRANSFORMER

Here's a comparison that you should make . . . hook up a cold cathode or long, slim fluorescent lamp with the correct SOLA Transformer . . . then, make the same hook-up using any other transformer that you care to select . . . now, vary the primary voltage.

Notice how the SOLA powered lamps maintain constant light output regardless of wide variations in the supply line voltage . . . and notice how the other lamp reacts under the same conditions—fluctuating in light output with each fluctuation in the supply line voltage.

Try this test and discover for yourself why it's a definite competitive advantage to list in your lighting specifications—"powered for CONSTANT LIGHT OUTPUT with SOLA Transformers."

SOLA Cold Cathode and "Thinline" transformers are available in both single and 2-lamp sizes, housed in compact ventilated cases.

LIGHTING ENGINEERS

For complete information and specifications consult these SOLA bulletins

Ask for Bulletins **JCC-107** **JFL-110**

SOLA *Lighting* TRANSFORMERS

Transformers for: Constant Voltage • Cold Cathode Lighting • Airport Lighting • Series Lighting • Fluorescent Lighting • Luminous Tube Signs Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • **SOLA ELECTRIC COMPANY, 2525 Clybourn Avenue, Chicago 14, Illinois**

ARTCRAFT IS SHOW CASE LIGHTING AT ITS BEST

FINEST QUALITY

Fluorescent

LIGHTING FIXTURES for SHOW CASES

Fabricated of the finest stainless steel - far more costly than ordinary metals - yet priced to meet competition. A lifetime rust proof finish. Supplied complete with all attaching parts. These parts are made of brass, plated to match, and designed to make all installations quick and easy.

Artcraft Fluorescent Show Case Lighting Fixtures come in all lengths to fit standard show cases, or made to specifications.

Made and wired by union labor. U.L. Approved.

ARTCRAFT FLUORESCENT CORP.

DESIGNERS & MFRS. OF MODERN LIGHTING FIXTURES

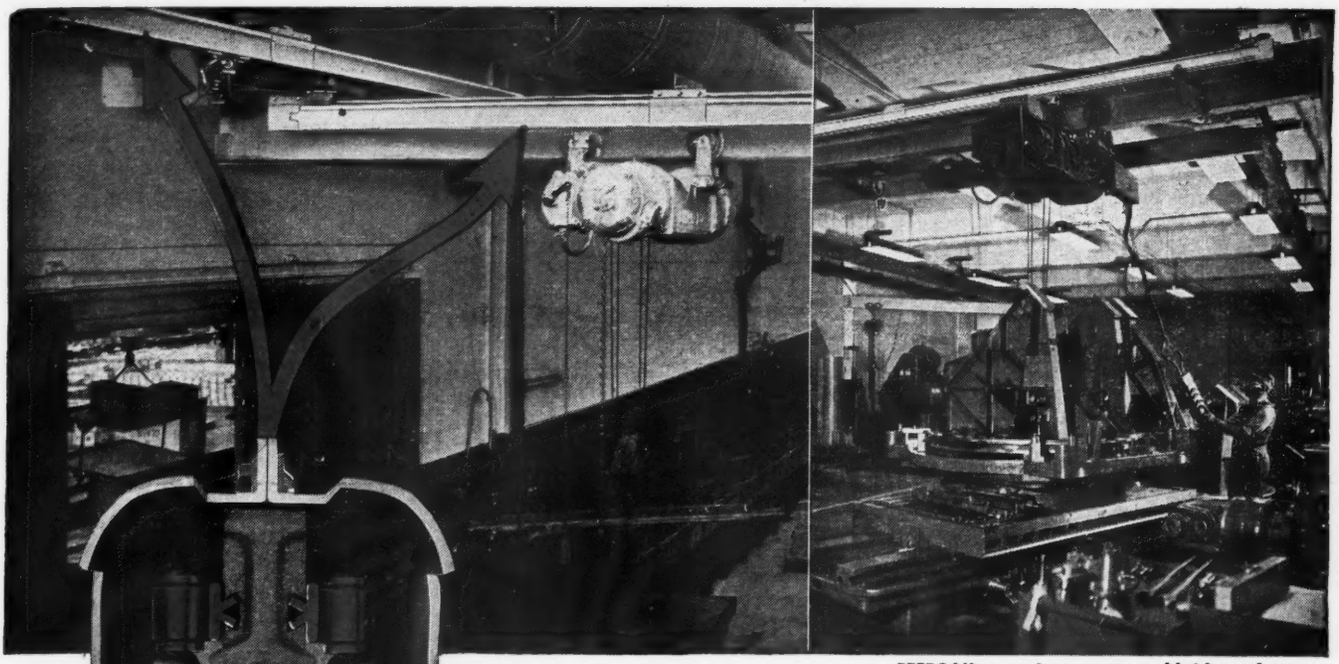
248-274 McKibbin Street

Brooklyn 6, N. Y.

Send for literature and price list

Rush your sample order now!

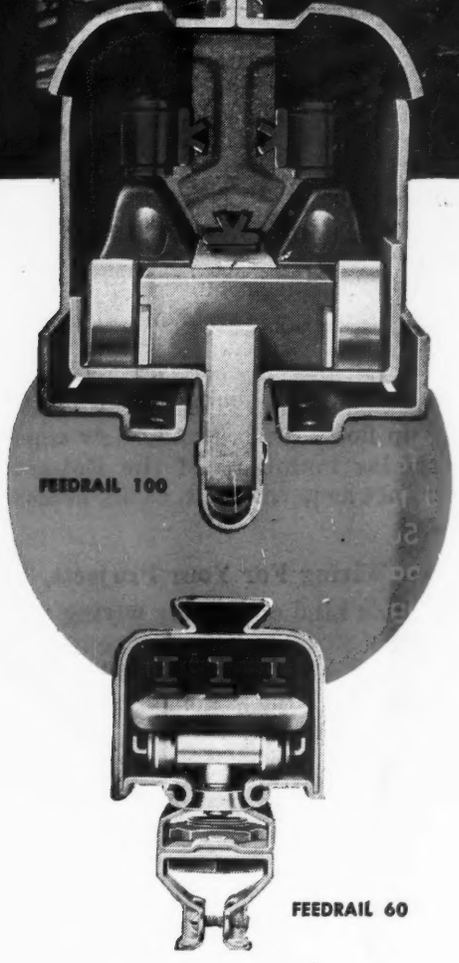
IMMEDIATE DELIVERY!



FEEDRAIL on main runways and bridges of cranes

MODERNIZE

YOUR CRANES AND HOISTS WITH FEEDRAIL



Exposed trolley wires have no place in a modern plant. In a day's time, you can substitute the enclosed ELECTRIC FEEDRAIL System.

It requires little space, and is furnished in assembled units in stock lengths and curves. Also available for transfers and switches to fit any desired layout.

Feedrail is mechanically strong, electrically foolproof. Trolleys are completely polarized. All electrical parts enclosed, protected against dust — accidental shorts — mechanical injuries.

AND HIGH CYCLE TOOLS

Feedrail is also designed especially for high cycle and portable tools and is used extensively for moving test racks.

Ask for

ELECTRIC FEEDRAIL
CATALOGS GENERAL No. 15
NEEDLE TRADES No. 16
MACHINE TOOL No. 17

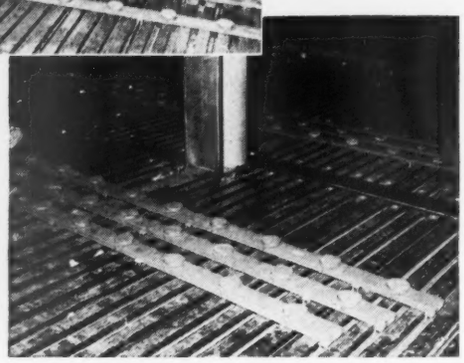
ELECTRIC FEEDRAIL

FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company

125 BARCLAY STREET NEW YORK 7, N. Y.

Header ducts in place showing how Q-Floor installation follows closely behind steel framework.



Installation view shows arrangement of header ducts which permits tenant to locate new outlets at any time, anywhere in the floor, on 6-inch centers.

ALL 24 FLOORS OF NEW TEXAS BANK TO GET Q-FLOOR WIRING

The electrical flexibility, convenience, and permanence of General Electric Q-Floor Wiring are strikingly demonstrated by a current installation in the new City National Bank in Houston, Texas.

Upon completion, this large project will be well equipped to handle all immediate needs for electrical services. In addition, provisions for future requirements are literally built into the permanent distribution system. New outlets can be installed as required on six-inch centers anywhere in the entire 24 floor area. There is no need for tearing up floors and running new conduit. The cellular members of the Robertson Q-Floors act as permanent, easily accessible raceways.

Q-Floor Wiring For Your Projects, Too

While this kind of cellular wiring system is extremely suitable for monumental structures, it can just as easily be applied to small commercial buildings, hospitals, factories, laboratories. In fact, there is no type of building where Q-Floor Wiring cannot be successfully employed. To help you and your clients benefit by Q-Floor electrical flexibility, a nation-wide service organization is available to help you. A General Electric Q-Floor Field Specialist, or your nearest General Electric Merchandise Distributor, is prepared to offer complete layout and installation data.

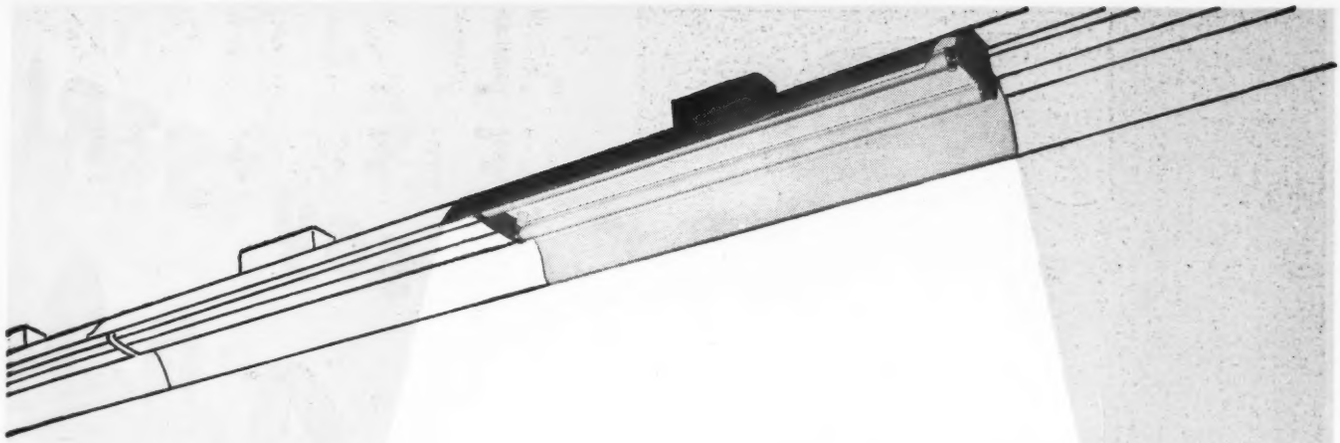
Q-Floor Information Offered

A comprehensive booklet containing descriptions, wiring diagrams, installation details, and other valuable information for architects, builders, and electrical contractors may be obtained by writing to Section C51-318, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

CONSTRUCTION DATA

Building:	*City National Bank, Houston, Texas*
Architect:	*A. C. Finn*
Structural Engineer:	*Robert Cummins*
Mechanical Engineer:	*Reg F. Taylor*
General Contractor:	*W. S. Bellows Construction Company*
Electrical Contractor:	*Schnorbus Electric Company*

GENERAL ELECTRIC



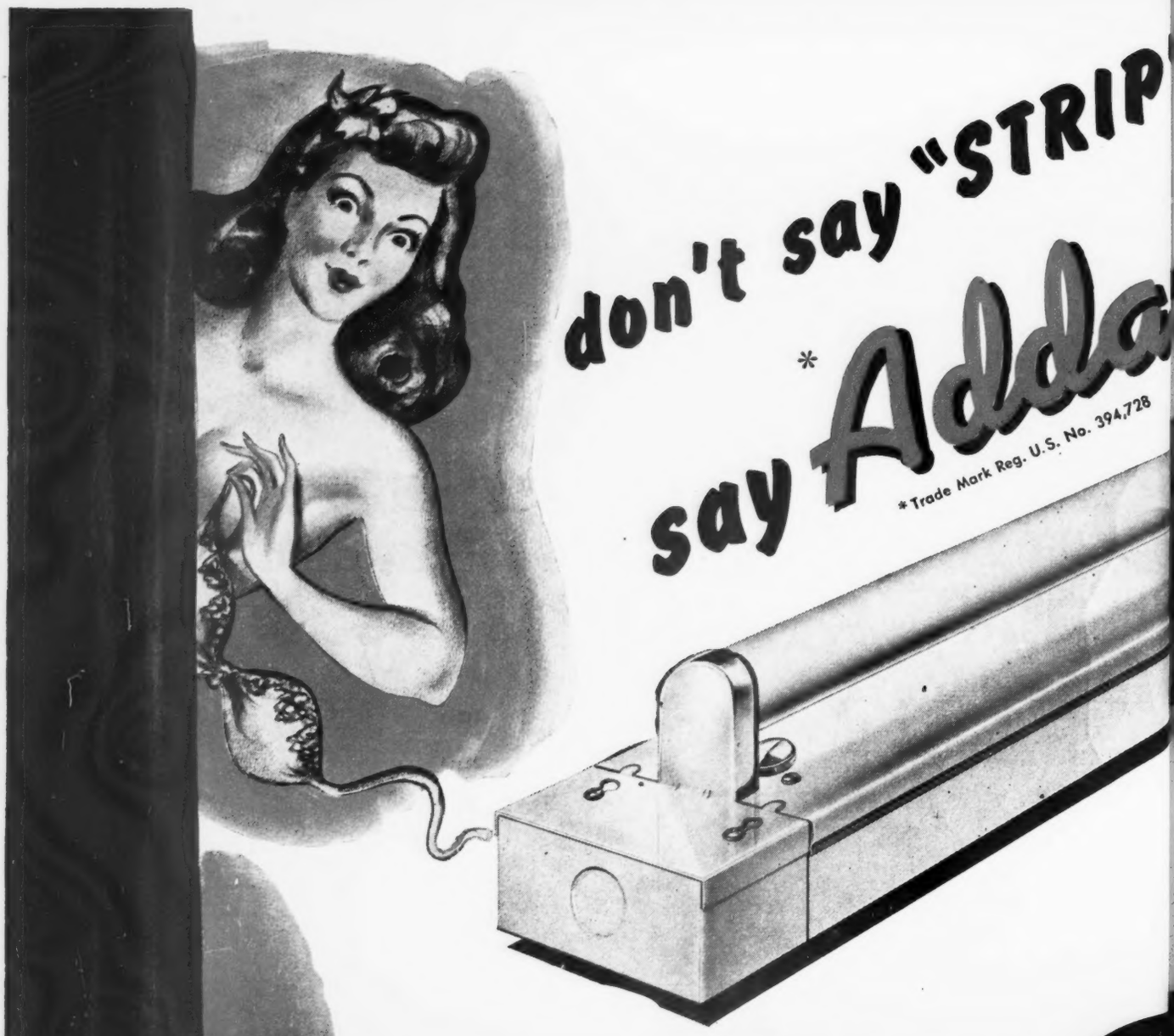
CHAN'L-RUN

The Basic Unit System

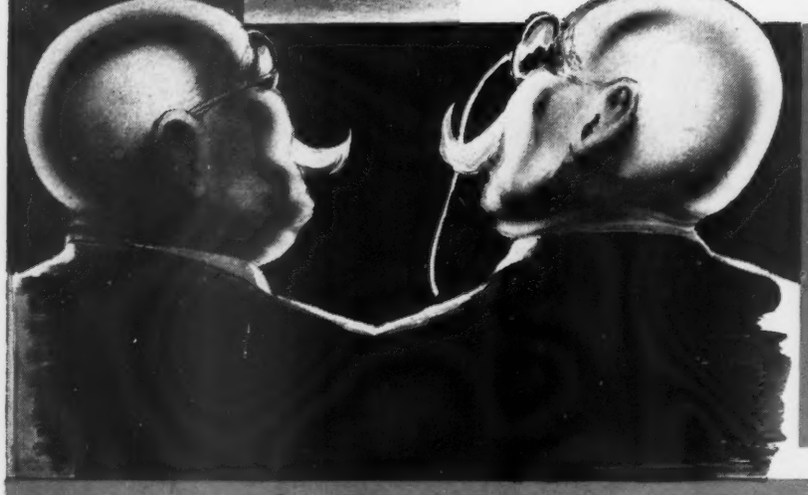
HOLDENLINE CO.

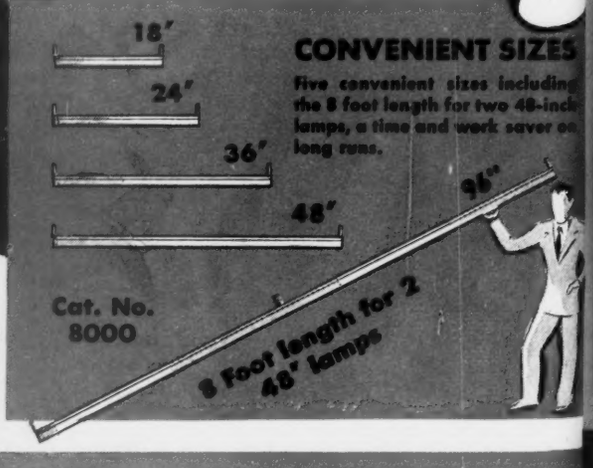
Pioneers in Fluorescent

2301 SCRANTON RD., CLEVELAND 13, OHIO



Also available in 2 Row, 100 watt and Slimline "Adda-Strip" . . . all with the same features as No. 8000 illustrated.





CONVENIENT SIZES

Five convenient sizes including the 8 foot length for two 48-inch lamps, a time and work saver on long runs.

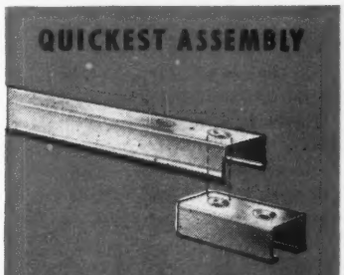
Established 1898

GARDEN CITY PLTG. & MFG. CO

Strip

LISTED BY UNDERWRITERS' LABORATORIES
Meets all code and installation requirements.

SOCKETS BACK TO BACK
No space lost between sockets. Single units or long runs, "Adda-Strip" gives you continuous line of light without gaps.

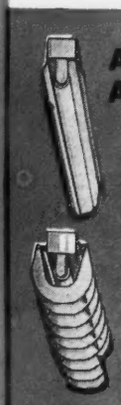


QUICKEST ASSEMBLY
One screw completes joint. "Nest together" embossings line screw holes up automatically.

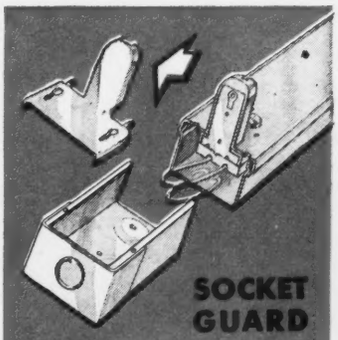
You'll save money in the long run... and the longer the run, the more you'll save. 18 inches or 18 miles, the unique construction and quality features of "Adda-Strip" add up to quick, inexpensive installations and permanently trouble-free jobs. Take a few moments to learn what "Adda-Strip" offers, and you, too, will resolve to always ask for "Adda-Strip."

COMPLETELY WIRED AND ASSEMBLED
... including starters and E.T.L. approved High Power Factor ballasts

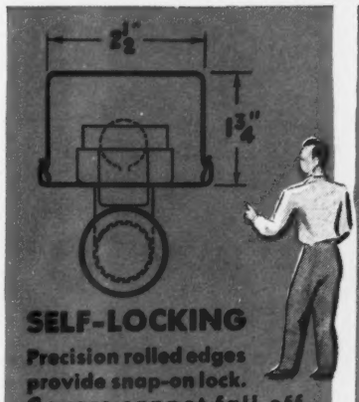
The ONLY Flourescent Line Lighting Source with All these Features!



ACCESSORIES AVAILABLE
Well designed reflector strips for every purpose! Complete, hinged louver shields to transform "Adda-Strip" into handsome louver fixtures! Handy! Easy to attach!



SOCKET GUARD
Metal end guard completely encases socket, protects it against breaking or bending.



SELF-LOCKING
Precision rolled edges provide snap-on lock. Covers cannot fall off.

LEAD WIRES
Only "Adda-Strip" provides. No. 14 lead wires on each end of each unit.

HEAVIEST GAUGE METAL
Does not distort or lose its shape.

A GARCY PRODUCT

Representatives Everywhere

CHICAGO 8, ILL.

NEW YORK OFFICE
AND WAREHOUSE—600 BROADWAY

ARROW Lock Switches

With CORBIN Pin Tumbler Locks

Keep control of the lighting in proper hands! Guard against unauthorized tampering with lights in schools, hospitals, theatres, auditoriums, hotels or any other building used by the general public.

The Lock Switches pictured here are no ordinary switches with locking device. They're time-tested ARROW Rotary Snap Switches, operated only by turning the key in a Corbin Pin Tumbler Lock.

No. 1281 is standard type, single pole, available also in double pole, 3-way and 4-way. No. 1281-WP is weatherproof, with cadmium-finish screw cap plate fitting on a weathertight rubber mat. No. 1291 is a *master* lock switch, reciprocating type. After inserting key in lock, switch may be turned to right or left — ON or OFF, but key cannot be removed from switch in ON or OFF position. Write for data sheet on this *complete* line.

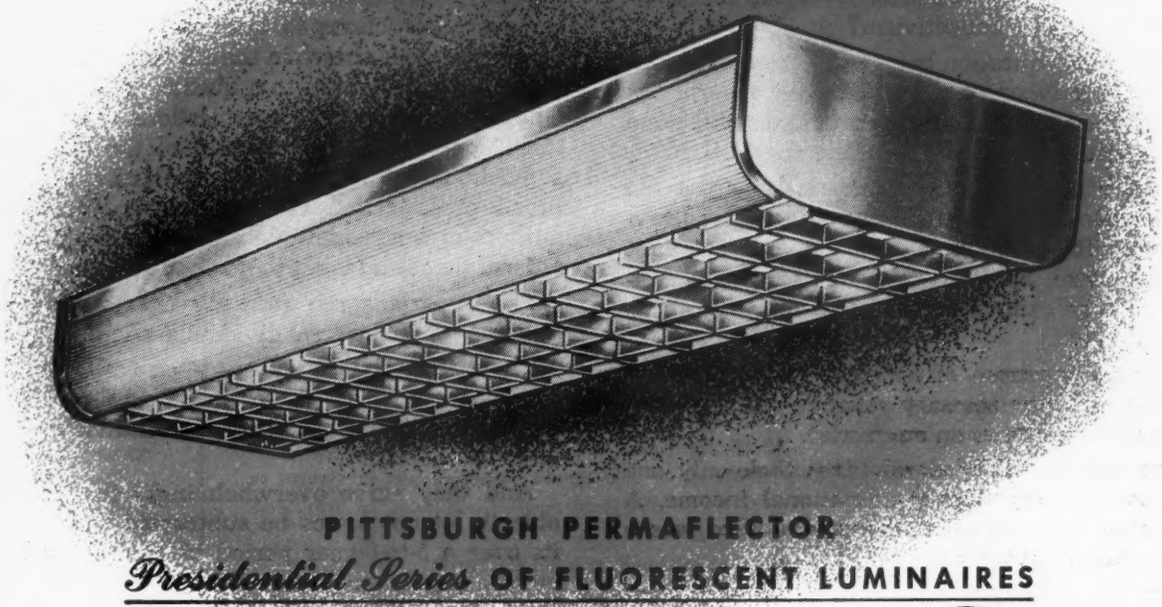
DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

ARROW ELECTRIC DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

Something Better Has Come to Light

A LINE YOU CAN PROFIT BY . . .
EQUIPMENT YOU CAN SELL!



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***Presidential Series* OF FLUORESCENT LUMINAIRES**

"Pittsburgh" Permaflector

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For surface or pendant mounting—individually or in continuous row. Egg-crate louver bottom hinged for easy maintenance. Two, three and four-lamp models.

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There's a Permaflector for Every Purpose

NOW AVAILABLE . . .

PITTSBURGH PERMAFLECTOR CATALOG 46

This 124-page Catalog gives timely lighting data and illustrates the complete line of Permaflector Incandescent Lighting Equipment. We will gladly send you a copy on request.

PITTSBURGH Reflector Company

OLIVER BLDG., PITTSBURGH 22, PA.

MANUFACTURERS OF FLUORESCENT AND INCANDESCENT LIGHTING EQUIPMENT

Permaflector Lighting Engineers in All Principal Cities

TAX REVISION...

Can Make or Break American Business

IS THE American way of life—progress by private initiative—going to get a fair chance to demonstrate its superiority over all the challenging varieties of collectivism?

That's the real question before Congress as it confronts the long labor of remodeling the federal tax structure. What Congress does about taxes will come pretty close to making or breaking the U.S.A.

Today the tax colossus that sprawls across the national economy is unguided by any central nervous system. Its crushing weight comes down first here, then there, as the giant wobbles around, unguided by any central purpose except to grab as much as it can.

The central purpose of a tax system is simple. It should raise the necessary revenue without placing unnecessary fetters on enterprise.

As recently as 1929 federal taxes took only one dollar out of every twenty of national income. A loose-jointed and inconsistent tax structure was a nuisance then. But it wasn't serious.

Today the federal tax burden is the dominant element in the nation's economy.

Even if Congress succeeds in cutting $6 billions out of President Truman's $37.5 billion budget, federal taxes still will take about one dollar out of every five of the national income. And few Congressmen are hopeful enough to think that they can get the tax load below $25 billion for any year that is in sight.

Drastic Budget Cuts Required

Indeed, to get the tax load down to $25 billion, Congress will have to stop treating expenditures, like those for military purposes and veterans, as politically sacrosanct. Congress must scrutinize *every* item in the budget. Economy must go along with tax cutting or we shall end in bankruptcy.

Suppose that expenditures are slashed to the bone. Our taxes *still* will be so heavy that the *way* they are loaded on the nation's back will make a big difference in how well the nation gets along. That's something which the postwar boom has tended to obscure. It will become much clearer as this boom wears off. Then a remodeling of the federal tax system to remove its manifold obstructions to private enterprise will be of transcendent and obvious importance to everybody.

Tax Experts Agree

The remodeling will require political courage plus tax wisdom. Congress must supply its own political courage. But it can lean on tax experts for tax wisdom. Fortunately, tax experts now agree on the necessary reforms—especially on those that will remove obstructions to business. How well the tax experts agree is shown in the charts on the next page, summarizing answers to a questionnaire on possible federal tax reforms. The questions were asked by the Department of Economics of the McGraw-Hill Publishing Company. The answers came from a broad cross-section of tax experts, including the authors of a considerable crop of books on postwar federal taxes and what to do about them.

The experts agree (see the charts) that double taxation of corporate dividends should stop.

They agree that the tax rate on corporate income (now 38 percent) should be reduced as rapidly as possible to the initial rate on individual income (now 20 percent).

And they agree overwhelmingly that it is desirable to let net losses be subtracted from net profits over a 5-to-6-year period in computing business income for tax purposes.

All three changes would stimulate corporate initiative and hence make jobs. Averaging business incomes would make new ventures attractive even though these ventures *might* result in early losses. Reduction of the corporate income tax would have the same effect. So, too, would the elimination of that highly discriminatory provision whereby corporate dividends are taxed first as corporate profits, and again when received as income by individuals.

Penalties on Incentives

Beyond these changes, there must be an end to tax penalties on *individual* initiative. Consider the enterprising business man whose income fluctuates markedly from year to year. Because of his enterprise he may pay, on the same income, twice as much federal income tax as the man who plays it safe for a steady income. That's because he can't average his personal income over several years for tax purposes. He can count on heavy taxation of his good-year profits with no chance for offsetting against them his bad-year losses. It is a case of heads you lose, tails the tax collector wins. Eighty-six percent of the experts agree that an income-averaging allowance for individuals is desirable.

Three-quarters of them also agree that tax rates at the top end of the individual income scale (now running up almost to 90 percent) should come down. In my judgment, the total tax should not amount to more than 50 percent to encourage business men to venture for high stakes.

Advocating tax relief for men in the higher income brackets—and particularly for management men—has been considered political suicide for more than a decade. Some members of Congress still hold that view. A Democratic Congressman from Michigan told an Illinois colleague who advocated cutting upper bracket taxes, "If you put that idea forward at home, you won't come back."

The Congressman has an even better chance of not going back if our economy bogs down. One of the best ways to bog it down is to keep the taxes that destroy business incentives and block enterprise—for example, the confiscatory rates which drive the people in the high brackets away from risk-taking.

To give the American system of individual enterprise a fair chance was clearly the mandate of November's election. To give it that chance, enterprising business men must have a chance to make large rewards—as well as the always-present chance to lose their shirts. Under present tax rates, they don't get a break.

Prevailing federal taxation throttles bold business enterprise in other ways. It fails, for example, to encourage research and rapid industrial modernization. It tends to siphon investment away from private enterprise, driving it into tax exempt state and local securities. (The experts agree almost to a man that such tax exemption must be eliminated.) The list of obstacles could be amplified.

Hit-and-Run Revision Disastrous

Most of the reforms needed to prevent the federal tax system from smothering enterprise would lower federal revenues, at least temporarily. Elimination of the double taxation of corporate dividends might lop off $800 million. Dropping the corporate income tax from 38 percent to 20 percent might cut away as much as $4 billion.

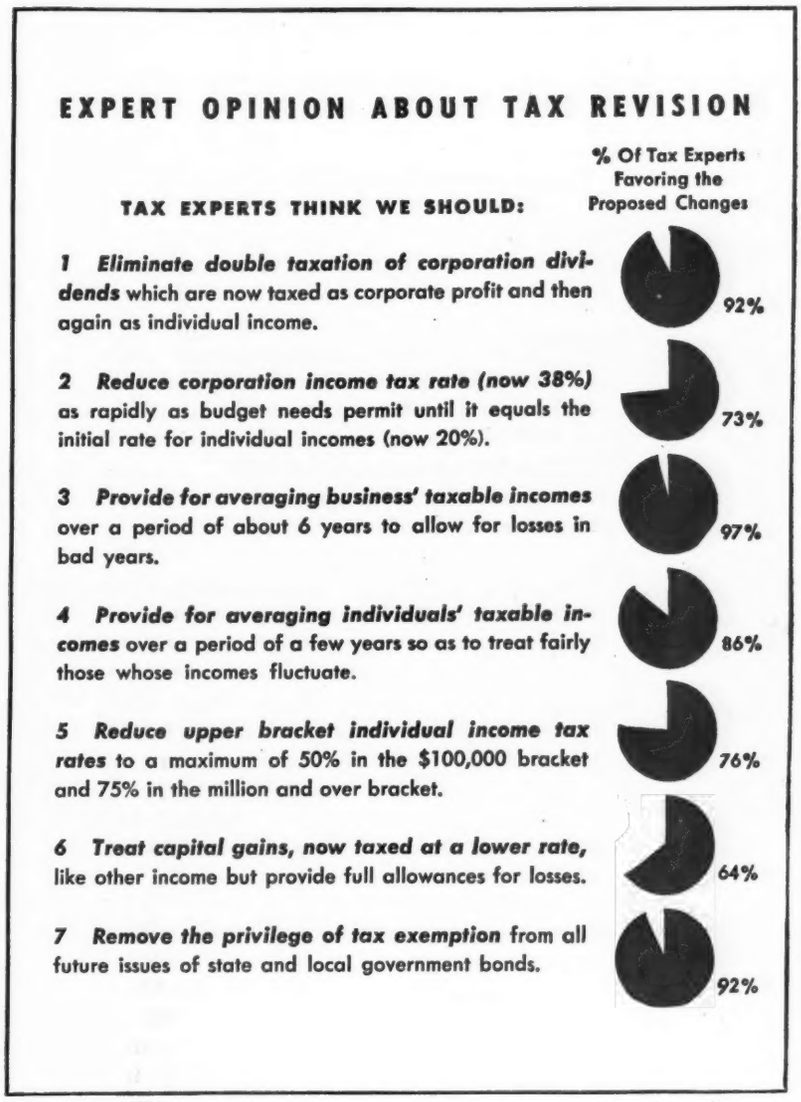
Because we can not avoid enormous federal expenses in the years immediately ahead, all badly needed reforms of the type to which this article is confined obviously can't be made at once. Also there are other tax reforms bearing on consumption which obviously should be weighted in an over-all program of tax revision.

But this is equally obvious: We should have a general design for tax revision which would line up all the necessary steps. Then we could get ahead with tax reductions as rapidly—and as sensibly—as revenue requirements and political courage would permit. Tax cutting may come piece-meal, but tax planning must not.

Through such a design we might discover that some decidedly beneficial improvements in the federal tax structure can be made at relatively slight cost. But today there's no way to be sure. No one in Washington with access to the information has even undertaken to make the necessary estimate.

Instead, federal tax revision continues to be a hit-and-run business—and a short-run political business. Take, for example, the proposal of a 20 percent tax reduction across the boards. There are virtues in such a proposal. But how they stack up beside many other extremely urgent needs for tax reform remains a mystery.

Congress must dispel such mysteries. Only in that way will it do the job of converting our present jerry-built tax structure into a moderately safe abode for the American system of private initiative, sparked by adequate incentives.


EXPERT OPINION ABOUT TAX REVISION
% Of Tax Experts Favoring the Proposed Changes
TAX EXPERTS THINK WE SHOULD:
1 Eliminate double taxation of corporation dividends which are now taxed as corporate profit and then again as individual income.
92%
2 Reduce corporation income tax rate (now 38%) as rapidly as budget needs permit until it equals the initial rate for individual incomes (now 20%).
73%
3 Provide for averaging business' taxable incomes over a period of about 6 years to allow for losses in bad years.
97%
4 Provide for averaging individuals' taxable incomes over a period of a few years so as to treat fairly those whose incomes fluctuate.
86%
5 Reduce upper bracket individual income tax rates to a maximum of 50% in the $100,000 bracket and 75% in the million and over bracket.
76%
6 Treat capital gains, now taxed at a lower rate, like other income but provide full allowances for losses.
64%
7 Remove the privilege of tax exemption from all future issues of state and local government bonds.
92%

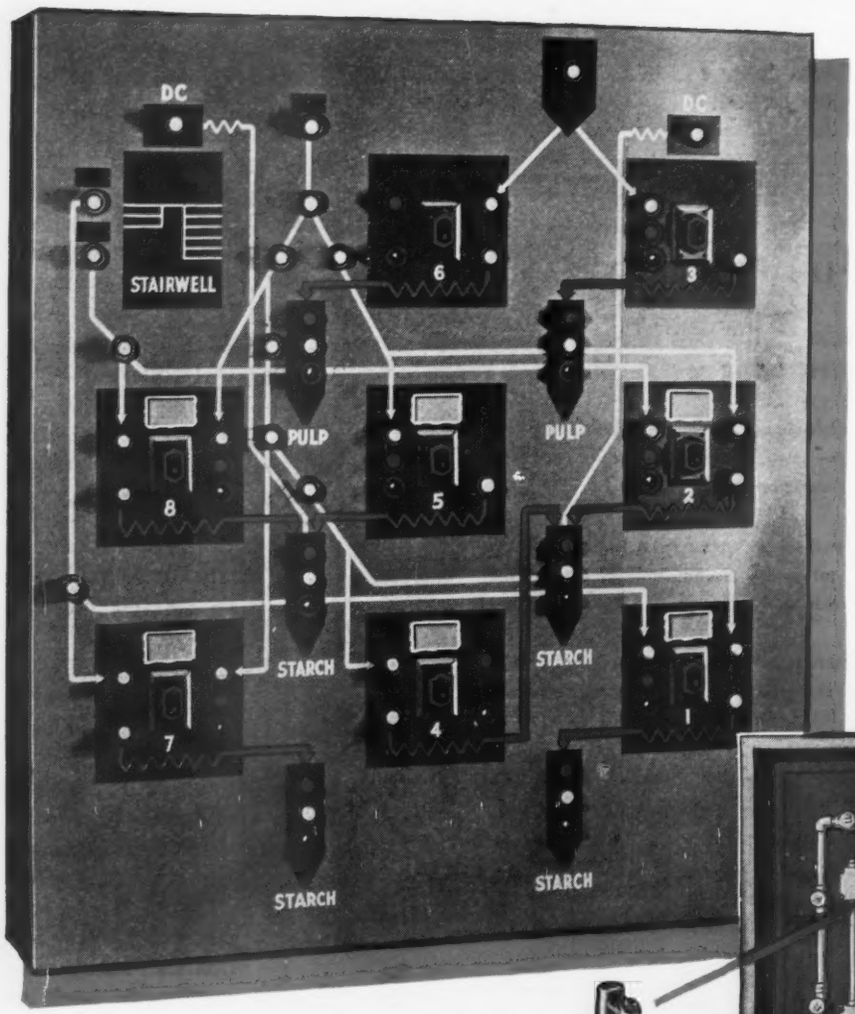
James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

THIS IS THE 56TH OF A SERIES

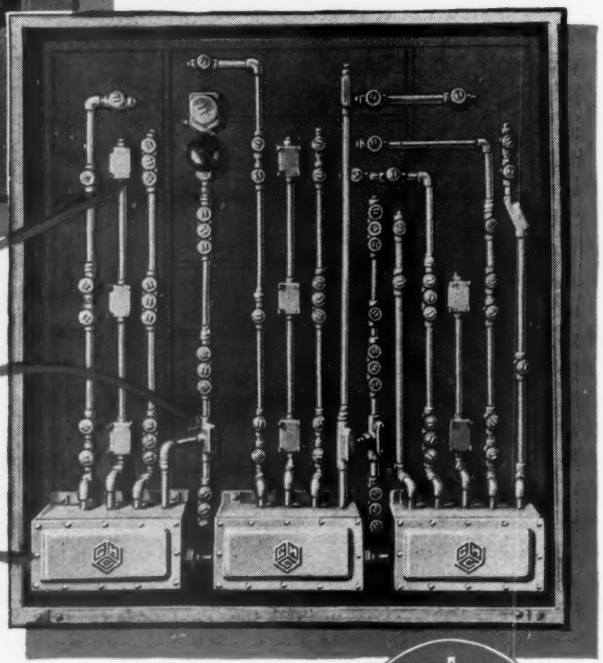
Central flow-line boards for the control of modern industrial processes

are easy to design with CROUSE-HINDS complete line of panel mounting *CONDULET equipment for hazardous locations



Crouse-Hinds panel mounting pilot lights and switches provide visual indication of process stages and instant control of processing or manufacturing equipment. The illustrations show front and back views of a flow-line control board in a starch plant where combustible dust creates a Class II (National Electrical Code) hazardous location.

* *CONDULETS are made only by CROUSE-HINDS*



Type EYS Explosion-Proof Sealing Condulet

Type GUAT Explosion-Proof Junction Condulet

Type EJB Explosion-Proof Junction Condulet

The pilot lights and switches are dust-tight and explosion-proof and are designed for both Class I and Class II hazardous locations. A similar control board for use where flammable gases or vapors create a Class I hazardous location would only require substitution of explosion-proof junction Condulets and the addition of explosion-proof sealing Condulets, as indicated. →

Write for additional information.

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Our 50th Anniversary 1897 – 1947

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CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

MARCH . . . . at a Glance

Lighting Competition

Merit awards totalling $1200 will be given outstanding examples of planned lighting at the International Lighting Exposition in November. This is an opportunity for electrical contractors, utilities, architects, engineers and wholesalers representatives to gain recognition for outstanding lighting jobs. Entries must be planned lighting installations made during 1946 and 1947. There are classifications for each segment of the industry and a total of twelve cash prizes. Official entry blanks may be obtained by writing to the International Lighting Exposition Award, Suite 818, 326 West Madison Street, Chicago, Illinois. Here is a good chance to attain national recognition for your work in modern lighting installation. We hope that the electrical contractor entries will top all of the others.

Figuring Underground

On page 65, Ray Ashley presents another of his authoritative articles on the subject of estimating electrical construction work. This time it is an appraisal of the problems encountered, and sample estimates exemplifying the techniques and methods used in figuring this kind of electrical work. Those of you who have been following Mr. Ashley's articles on estimating will be glad to know that the manuscript of a book covering the whole field of electrical construction estimating, written by Mr. Ashley, is now in the process of publication and should be available in the not too distant future.

Farm Electrification

One of the major markets for electrical construction in the years immediately ahead is in the rural areas where the electrification of farm processes," "electro agriculture," is making long strides ahead. Farm wiring was once a specialized type of residential work. Today its problems are more closely related to those found in small industrial plants. Wiring must be designed to meet many unusual environmental conditions and unusual load requirements. Gus Eckel, Middlewest Editor, has spent many months accumulating the most up to date market information and the best data available on farm wiring methods. You will find it in this month's editorial feature section on "Farm Wiring—an expanding market," beginning on page 77.

Television Antennas

Back in November we commented on this page about the problems television manufacturers were going to encounter in installation due to lack of facilities for the critically important television aerial. The problem suddenly came to a head last month in New York when thousands of apartment house tenants received warnings from their landlords that individual television antennas would not be tolerated and were advised to defer the purchase of such equipment until such time as central television antenna systems are available and can be installed. Your editors are following the situation closely and as soon as the television equipment manufacturers are prepared to market effective multiple antenna systems, we'll bring you the story.

No Breakdowns Allowed

When the deadline bell rings at the Daily News plant in New York, the presses start to roll and they must keep rolling to get the enormous edition on to the streets and into the homes of New York City and surrounding areas. Under such high pressure operation, motor or electrical equipment breakdowns cannot be tolerated. John Peters, who is in charge of electrical maintenance and installation, reports only five motor failures in seventeen years, an extraordinary record which took methodical operation and management of the department. You will find the story, which contains many useful methods readily applicable to other electrical maintenance problems, on page 71.

Safety Lighting

If you drive out of the Holland Tunnel into Jersey over the Pulaski Skyway, you will find yourself on the world's most travelled highway, New Jersey's Route 25. New Jersey's million-dollar-a-mile super highway modernization program includes modern highway lighting at busy traffic points along this great artery. Electrical contractor A. Neri's job includes illuminated directional signs and thoroughly engineered highway lighting. You will find the story on page 68.

Industrial Lighting

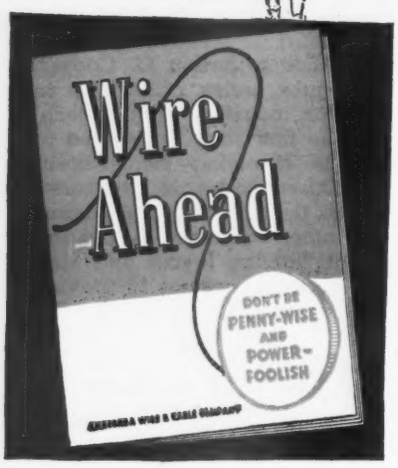
Eastern Editor, Berlon C. Cooper, begins a new series of articles in this issue on industrial lighting techniques. The first story is devoted to applications involving incandescent lamps. Other stories in the series will discuss the application of fluorescent and other light sources, lighting equipment, lighting layout and electrical distribution systems to provide better light for production. As the availability of industrial lighting equipment improves through the year, we believe that this thorough study of the problems and selection of light sources is particularly timely.

He makes production vanish!

HERE IS INDUSTRY'S most costly disappearing act! Are you *sure* there's none of this black magic in your plant?*

Inadequate Wiring, the industrial jinx, is at it every day. For overtaxed, overextended, obsolete wiring is cutting the efficiency of men and machines by 25 to 50 percent in hundreds of plants. Your plant power engineer, your consulting engineer, electrical contractor or utility power salesman can find this jinx . . . *and throw him out!* 47447

Because adequate wiring is basic ... and affects everyone in our industry ... Anaconda continues to promote this idea in a wide list of national magazines.



*WIRE AHEAD, a new booklet discussing preventive maintenance . . . the symptoms of inadequate wiring . . . and presenting plans for anticipating electrical demand, is now in preparation. We shall be glad to send it on request as soon as it is available.

ANACONDA
from mine to consumer

ANACONDA WIRE AND CABLE COMPANY

MARCH, 1947

IT DEFINES THE FIELD

ELECTRICAL CONSTRUCTION AND MAINTENANCE, which we have long carried on our cover as a definition of the field served by *Electrical Contracting*, becomes our new name with this issue. The name now defines the field of activity with which you, our readers, are concerned. It defines the field about which we and our editorial contributors report and write. It defines the field in which our advertisers seek to sell their products.

OUR POLICY IS UNCHANGED. We shall continue to serve electrical contractors, industrial electricians, electrical construction engineers, electrical inspectors and motor repair shops to the best of our ability. You will continue to find authoritative and timely articles about your industry, its engineering, installation, maintenance and management problems and its know-how written by contributors and editors qualified by technical training and practical electrical industry experience to report accurately and to write with mature judgment.

OUR NEW NAME IS TESTIMONY to broad developments that have already occurred in the industry, an evolution which is inherent in a dynamic field. Electrical contracting denotes wiring related to the construction of new buildings. The work of the electrical contractor today, however, is far more varied. For example, farm wiring, airport lighting, factory reconversion, wiring cargo vessels, office building rewiring, planned commercial lighting, television antenna system installations are typical everyday jobs completely unrelated to new building.

AS MARKETS HAVE BECOME more varied, the technology and the know-how of the industry have grown more complex. Once an industrial job meant just more and bigger pipe and wire and a few motor starters. Today it may involve a half dozen or more wiring systems of different voltages and frequencies, electronic communication systems, engineered lighting and precise automatic controls of a hundred varieties.

ELECTRICAL MAINTENANCE and repair have followed a parallel course. Upkeep, today, is a methodical, planned operation involving a high order of technical competence, know-how and skill. The great complexity of electrical apparatus and its application to industrial process is a tremendously challenging responsibility.

ELECTRICAL CONSTRUCTION, the wiring, installation and maintenance of electrical apparatus and equipment, wiring for convenient access and utilization and the installation of lighting systems, are functions which in the years ahead will take on more and more importance in the total scheme of electrification. It is through this activity of ours that the products of the manufacturers and designers are brought together with vast sources of electrical energy for use by people. And in this field we can confidently predict is the greatest potential growth and opportunity of all the industry.

OUR NEW NAME REFLECTS the broader activities and responsibilities of the folks we serve more accurately than the old. It more clearly embraces our evident destiny. We hope that under it we shall be able to report, to counsel and to encourage toward that destiny better than ever. That's our job. To help carve out that destiny—well—that's your job, too.

Wm. F. Stuart

For that shop you're going to light . . .

GraybaR can help you choose and apply it

Whatever the lighting requirements, Graybar can impartially recommend the exact lighting equipment for your customer's needs from the most complete selection of lamps and lighting units available from any one source.

For general or local illumination — indoors or outdoors — Graybar can provide the latest, most suitable fixtures and matching G-E lamps — plus the wire, transformers, switches, and ballasts you need.

The near-by Graybar Lighting Specialist offers you his assistance in planning any lighting installation.

Our national warehousing system can simplify your procurement of "everything electrical" that your contracts require. For some items, demand still exceeds supply — but many are immediately available from our local stocks. Call our nearest office. *Graybar Electric Company. Executive offices: Graybar Building, New York 17, N. Y.*

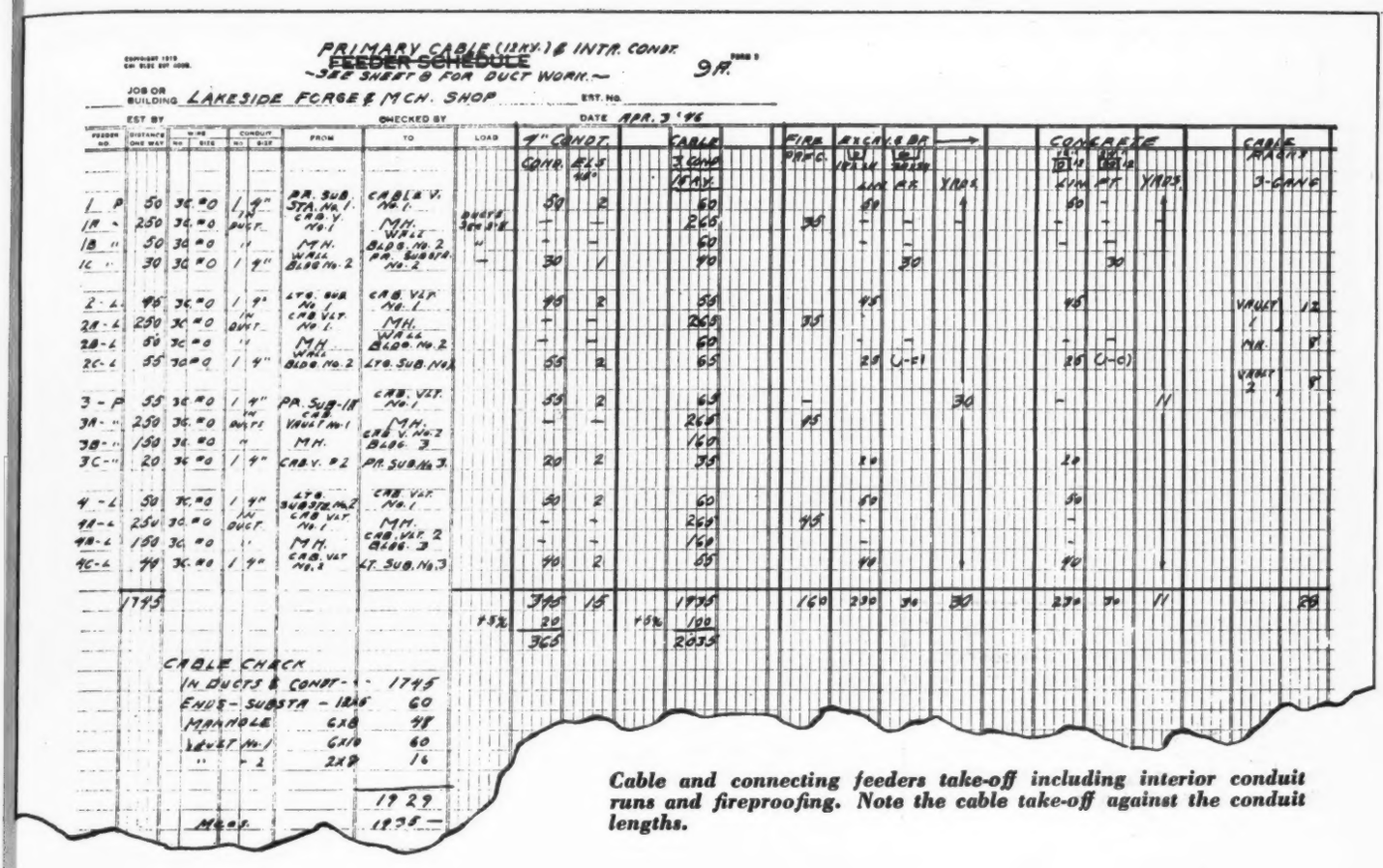
How Graybar Simplifies Your Electrical Buying

Graybar makes it possible for you to obtain — from a single convenient source — more than 60,000 electrical items, made by over 200 leading manufacturers. Through its 95 offices and warehouses, Graybar shortens the economic distances between 200 makers and 35,000 users. One order, one responsibility, one invoice does the work of many. 4734

Everything for Electrical Contractors via GraybaR

IN OVER 90 PRINCIPAL CITIES

WIRING • LAMPS and LIGHTING • COMMUNICATION • SIGNALING • VENTILATION • CONTROL • POWER APPARATUS • TOOLS



PRIMARY CABLE (15 KV.) & INTR. CONDT.
~~FEEDER SCHEDULE~~
~SEE SHEET 9 FOR DUCT WORK.~
9A

JOB OR BUILDING LAKESIDE FORGE & MCH. SHOP EST. NO.

EST BY CHECKED BY DATE APR. 3 '46

FEEDER NO.	DISTANCE ONE WAY	WIRE NO.	WIRE SIZE	CONDUIT NO.	CONDUIT SIZE	FROM	TO	LOAD
1-P	50	3C	#0	1	4"	PR. SUB STA. NO. 1	CAB. V. NO. 1	DUCTS SEE SHT.
1A- "	250	3C	#0	1 IN DUCT		CAB. V. NO. 1	MH. WALL BLDG. NO. 2	"
1B- "	50	3C	#0	"		MH. WALL	BLDG. NO. 2	"
1C- "	30	3C	#0	1	4"	MH. WALL BLDG. NO. 2	PR. SUBSTA. NO. 2	—
2-L	95	3C	#0	1	4"	LTG. SUB NO. 1	CAB. V. LT. NO. 1	
2A-L	250	3C	#0	1 IN DUCT		CAB V. LT. NO. 1	MH. WALL BLDG. NO. 2	
2B-L	50	3C	#0	"		MH. WALL	BLDG. NO. 2	
2C-L	55	3C	#0	1	4"	BLDG. NO. 2	LTG. SUB. NO. 2	
3-P	55	3C	#0	1	4"	PR. SUB-1B	CAB. VLT. NO. 1	
3A- "	250	3C	#0	1 IN DUCT		CAB VAULT NO. 1	MH. CAB. V. NO. 2 BLDG. 3	
3B- "	150	3C	#0	"		MH.	"	
3C- "	20	3C	#0	1	4"	CAB. V. #2	PR. SUB NO. 3	
4-L	50	3C	#0	1	4"	LTG. SUBSTA. NO. 2	CAB. VLT. NO. 1	
4A-L	250	3C	#0	1 IN DUCT		CAB. VLT. NO. 1	MH. CAB. VLT. 2 BLDG. 3	
4B-L	150	3C	#0	"		MH.	"	
4C-L	90	3C	#0	1	4"	CAB. VLT NO. 2	LT. SUB. NO. 3	
	1745							

4" CONDT. CONN.	4" CONDT. ELS	4" CONDT. 45°	CABLE 3 CONDR. 15 KV.	FIRE PROTC.	ALCAN 6 BR. 1/0 AL	ALCAN 6 BR. 350 MCM	ALCAN 6 BR. AR.	ALCAN 6 BR. XMFR.	CONCRETE 12"	CONCRETE 18"	CONCRETE XMFR.	CABLE MAGTY 3-CONR.
59		2	60			59		1	60			
—		—	265	35		—	—	—	—	—	—	
—		—	60			—	—		—	—		
30		1	90				30			30		
95		2	50			95			95			VAULT 1
—		—	265	35		—						NR.
—		—	60			—	—		—	—		
55		2	65			25	U-E1		25	(L-C)		VAULT 2
59		2	63	—				30	—		N	
—		—	265	35								
20		2	35			20			20			
50		2	60			50			50			
—		—	265	35		—			—			
—		—	160			—			—			
90		2	65			90			90			
745		15	1745	160	230	30	30		270	30	11	28
	5%		100									
365			2035									

CABLE CHECK

IN DUCTS & CONDT. -		1745
ENDS - SUBSTA - 12	6	60
MANHOLE	CAB	48
VAULT NO. 1	CAB	60
" - 2	2 X 8	16
		1929
MISC.		1935

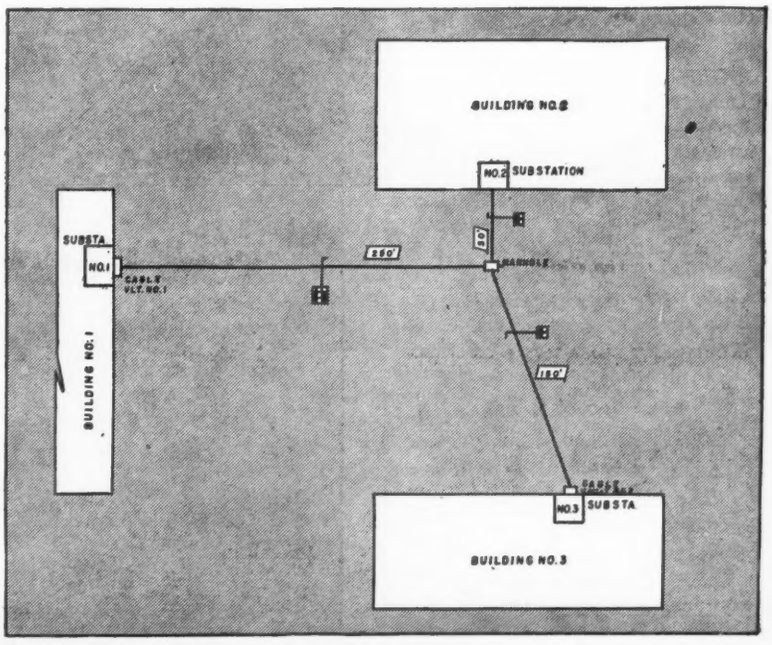
Cable and connecting feeders take-off including interior conduit runs and fireproofing. Note the cable take-off against the conduit lengths.

Figuring UNDERGROUND WORK

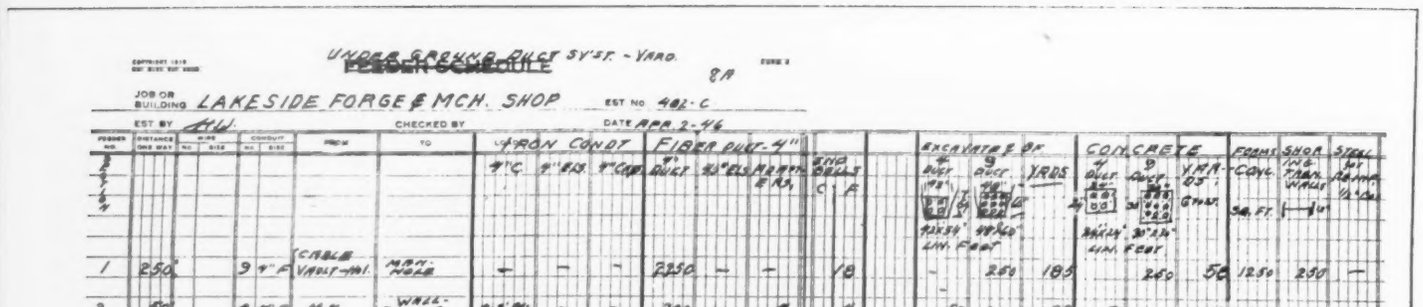
How to estimate costs of installing underground conduits and feeders. Basic cost data with detailed sample estimate sheets.

By Ray Ashley

ESTIMATING underground work requires an eagle eye for "minor" details, a sound understanding of the variety of conditions that can affect costs and ample on-the-job experience. This sample estimate shows the base cost for the underground portion of an industrial project. The sheets illustrate the type of job frequently encountered where several buildings are served from one main power service. One can acquire from



Feeder distribution plan showing underground connections between three buildings upon which the sample estimate is based.



Check List For Underground Work

TRENCHING & CONCRETE
Excavating
Backfilling & Tamping
Shoring Trench Walls
Water Pumping
Concreting
Forms (Concrete)
Reinforcing Steel
Removing Excess Soil
Removing Pavements
Replacing Pavements & Roadways

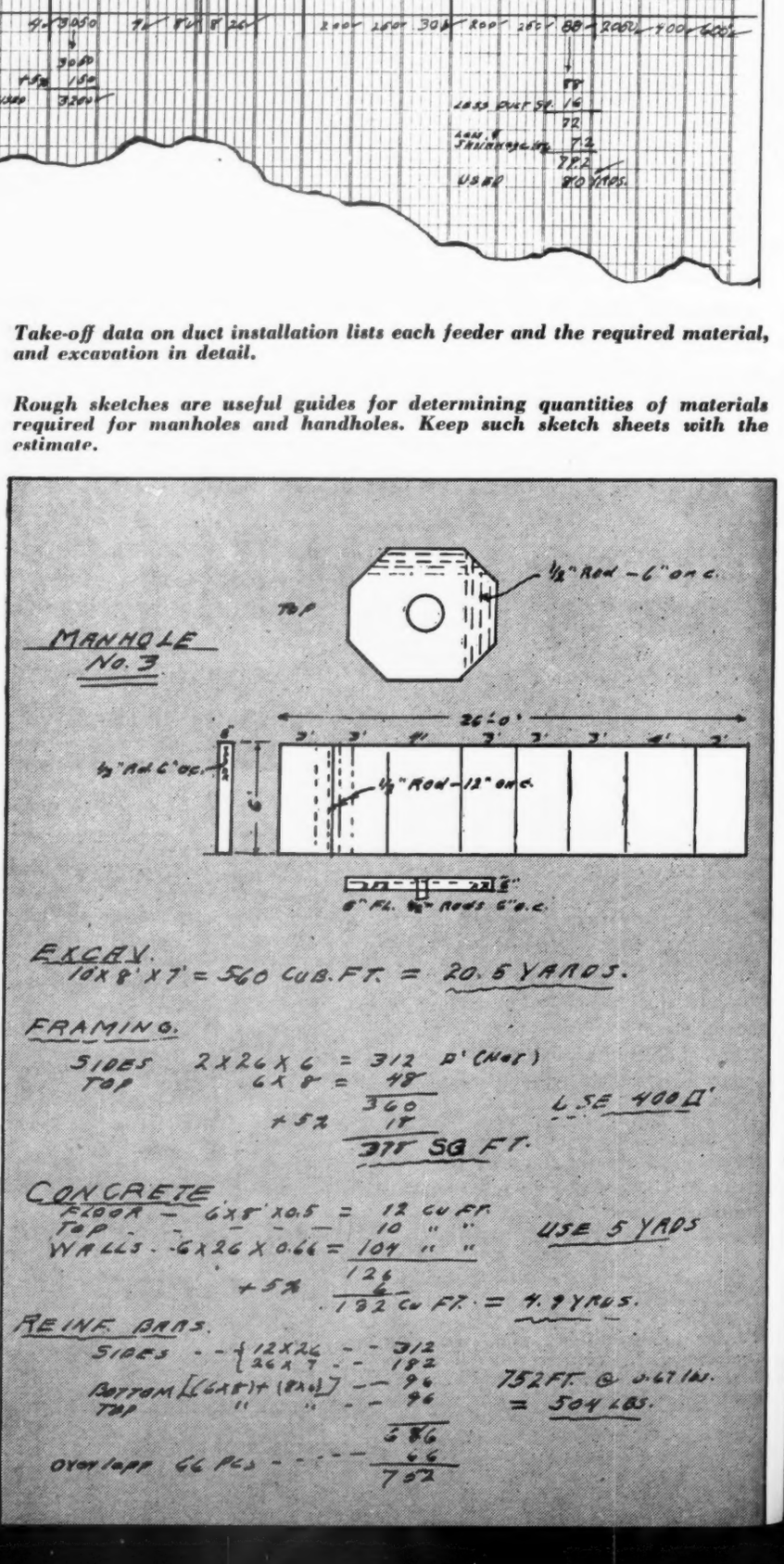
MANHOLES
Excavating
Shoring
Forms (Concrete)
Reinforcing Steel
Covers & Frames
Drains
End Bells
Pulling Irons
Pumping Water
Refilling
Removing Excess Dirt

DUCT WORK
Conduit & Ducts
Elbows
Adapters
Duct Spacers
Sleeves
Pipe Caps
Rodding Ducts
Fish Wires
Sealing Duct Ends

CABLE INSTALLATION
Cables
Miscellaneous Control Cables
Splices
Cable Racks
Fire Proofing
Tagging
Bonding
Testing

Take-off data on duct installation lists each feeder and the required material, and excavation in detail.

Rough sketches are useful guides for determining quantities of materials required for manholes and handholes. Keep such sketch sheets with the estimate.


MANHOLE NO. 3
TOP
½" Rod - 6" on c.
26'-0"
½" Rod - 12" on c.
½" Rod 6" o.c.
8" Fl. ½" Rods 6" o.c.
EXCAV.
10'x8'x7' = 560 CUB. FT. = 20.5 YARDS.
FRAMING.
SIDES 2x26x6 = 312 B' (Net)
TOP 6x8 = 48
360
+5% 18
378 SQ FT.
USE 400 B'
CONCRETE
FLOOR - 6x8'x0.5 = 12 Cu Ft.
TOP - - - 10 " "
WALLS - 6x26x0.66 = 104 " "
126
+5% 6
132 Cu Ft. = 4.9 YRDS.
USE 5 YDS
REINF. BARS.
SIDES - - { 12x26 - - 312 / 26x7 - - 182
BOTTOM [(6x8')+(8x6')] - - 96
TOP " " - - 96
586
OVERLAPP 66 PCS - - - - 66
752
752 FT. @ 0.67 LB.
= 504 LBS.

Underground conduit work pricing sheet as developed from take-off sheet totals.

the study of such data alone an idea of the numerous items of material and labor embraced by what seems to be a very simple undertaking.

Some of the work listed, such as reinforcing steel, shoring, and water pumping, may not be present on all such projects. On the other hand, many installations embrace such items as blasting rock, tearing up and replacing roads and pavements, special footings for concrete envelopes, and numerous other items of considerable expense.

The costs of the different branches of the work vary greatly. Soil conditions may be such that trench walls will have to be shored solid on either side. This not only represents an expensive item by itself, but the cross braces slow down other work. The amount of excavating may be greatly increased by loose sand, or the need of a runway along the duct formations.

In general, soil, weather, and water (underground) conditions present the greatest hazards. One may encounter anything from quick-sand to solid rock. Filled-in spaces are risky. The surfaces may be smoothed off, but when digging starts, old automobiles, tree stumps, boulders or any other rubbish likely to be taken to a city dump may be unearthed.

One could continue to great length enumerating the difficulties likely to be encountered in underground construction. The costs of materials shown are approximations for the purpose of this sample estimate and are intended solely as a guide to the method of tabulating and extending. The labor units also will vary with the experience of individual firms and available labor skills. Experienced estimators will quickly recognize that such units in a sample estimate must be adjusted to local cost conditions.

The apprentice estimators have to depend pretty heavily on those with experience, if they wish to keep out of trouble. The accompanying checklist, however, will furnish some suggestions of work to be included.

Cable and interior conduit run pricing sheet as developed from the totals on its related take-off.

PRICING SHEET DATE APR. 3 1946

JOB OR BLDG. LAKESIDE FORGE & MCH. SHOP LOCATION

BID TO ADDRESS

ARCHT. OR ENG'R. ADDRESS

PLANS ~~MARKED~~ PLOT & E-1 SCALE SPEC. No. EST. No.

EST. BY AW. PRICED BY EXTENSIONS BY CHECKED BY A.B. S.O. No. SHEET No. 8

MATERIAL	QUANTITY	MATERIAL UNIT	MATERIAL EXTENSION	LABOR UNIT	LABOR EXTENSION
~ UNDER GRND. WRK. & MH. ~ CABLE VAULTS BY O.				MAN HOURS	
4" FIBER DUCT	3200'	10 cts/ft	576.00	.08	256.—
4" ELS. - FIBER - 45°	4	3.25	13.00	1.5	6.—
ADAPTERS - 4" Fiber to Cond.	8	1.00	8.00	1.5	12.—
END BELLS - 4" F.	26	.92	24.00	1.	26.
" " 4" C.	8	1.00	8.00	1.5	12.
2'-0" PCS. 4" CONDT. - Threaded	12	3.50	42.00	1.	12.
EXCAVATE & B.F. {92"X54"=200' / 96"X60"=250'} YARDS	300	—	—	1.5	450.
CONCRETE {24"X20"=200' / 30"X30"=250'} YARDS	80	10.00	800.00	9.-	720.—
FORMS FOR CONC. SQ. FT.	2100	.15	315.00	.01	21.—
SHORING - Trench 12"—18" LIN. FT.	400	.25	100.00	.05	200.—
REINFORCING - BARS - 1/2" SQ.FT.	600'	.06	36.00	.05	30.—
MANHOLE (See Sub. Sheet 6)	G.C. BID		550.00	—	—
CABLE VAULTS	2	By O.	—		—
DUCT SPACERS 26.	80	.41	32.00	.15	12.—
" " 36.	100	.50	75.00	.15	22.5
WATCHING DUCT C Concreting	Days 5	—	—	8.—	40.—
RODDING DUCTS	3200'	—	—	.04	128.—
4" CAPS. I.C.	4	.50	2.00	5	2.—
PUMPING WATER M.H. & Sect. 3.	—		15.00		20.—
			2572.00	HRS.	2138.5
				@1.75	3780.00
NOTE - SURPLUS DIRT REM. BY O.					

PRICING SHEET DATE APR. 5 1946

JOB OR BLDG. LAKESIDE FORGE & MCH. ~~SHOP~~

BID TO ADDRESS

ARCHT. OR ENG'R ADDRESS

PLANS ~~MARKED~~ PLOT., E-1, E-3, E-4. SCALE SPEC. No. EST. No.

EST. BY PRICED BY EXTENSIONS BY CHECKED BY S.O. No. SHEET No. 9

MATERIAL	QUANTITY	MATERIAL UNIT	MATERIAL EXTENSION	LABOR UNIT	LABOR EXTENSION
~ PRIMARY CABLE & IRON CONDT RUNS ~ SEE SHEET 8 FOR U.G. DUCT SYST.				IN HOURS	
4" GALV. CONDUIT	370	80.00/C	296.00	0.30	111.—
4"-45° ELS & CPLGS.	15	12.00	180.00	2.5	37.5
SPECS P-10 [3 COND. #0, 15 K.V., P&L VULCANIZED CABLE]	2050	1450.00/C	2972.50	0.2	410.
SPLICES (3C, 15 K.V., #0)	3	12.00	36.00	20	60.—
4" INSUL. BUSH.	12	2.83	33.60	—	—
FIREPROOF CABLES	160	.20	32.00	.2	32.—
EXCAVATE & B.F. (200') YDS.	30	—	—	1.5	45.—
CONCRETE 230 CF - 30 CF YDS.	11	10.00	110.00	10	110.—
CABLE RACKS - 3 GANG - 1/2 CONDL.	28	3.50	98.00	2.5	70.—
BONDING. C.A.B. IN MH. & VLTS.	15	.50	7.50	0.4	6.—
TAGGING " (Lead Tags)	30	.10	3.00	0.1	3.
SEALING CONDT. ENDS.	51	.50	25.50	0.5	25.5
			3774.10	HRS.	910.—
				@1.75	1592.50
NOTE - TESTING TO BE INCL. WITH LUMP SUM SPECIFIED SEE DIR. JOB COSTS.					

Lighting The World's Busiest H

Accident preventing roadway lighting and illuminated directional signs are installed by Electrical Contractor A. Neri for New Jersey's million-dollar-a-mile super highway modernization program.

By Hugh P. Scott

MODERNIZATION of New Jersey's Route 25, "the world's most heavily traveled artery," is a major contribution to a greatly-needed plan for safely speeding the flow of motor traffic across the Eastern Seaboard's most congested area. Lighting, grading and paving a 3.2 mile section passing Newark Airport, including an important twin intersection with State Routes 21 and 29, marked the inauguration of the construction program. Contracts totaling $3,300,000 were awarded for this initial portion of the work. Of this amount, $184,000 covered the furnishing and installation of 365 ornamental highway lighting units, electrical directional signs and their supports, transformers, 36,000 feet of pole and bracket cable, 100,000 feet of trench lay cable and all necessary trenching. Electrical contractor A. Neri of Hoboken, N. J., was awarded the entire electrical contract although the civil engineering phase of the work was divided into four segments to increase competition and speed construction. All electrical work was designed and supervised by the state highway department's electrical division under the direction of chief electrical engineer James L. Hays, a representative for Government on the Illuminating Engineering Society's Committee on Street and Highway Lighting.

The new 8-lane highway is composed of twin two-lane express roadways with flanking double-lane roadways for local traffic. North and southbound express roadways are separated by continuous, raised, 16-foot-wide central islands while express and local uni-directional traffic is separated by 2-foot reflecting curbs. Air-entrained, non-scaling concrete lanes vary from 11 to 13 feet and shoulders on penetrating macadam increase each two-lane paved roadway to an overall approximate width of 34 feet. In the three mile sector, five overpasses eliminate grade intersections, improve traffic flow and minimize lane-crossing dangers. Construction was complicated by the facts that traffic demands required four lanes to be in continuous operation and the work was constantly in the vicinity of high tension electric lines and other buried utility services.

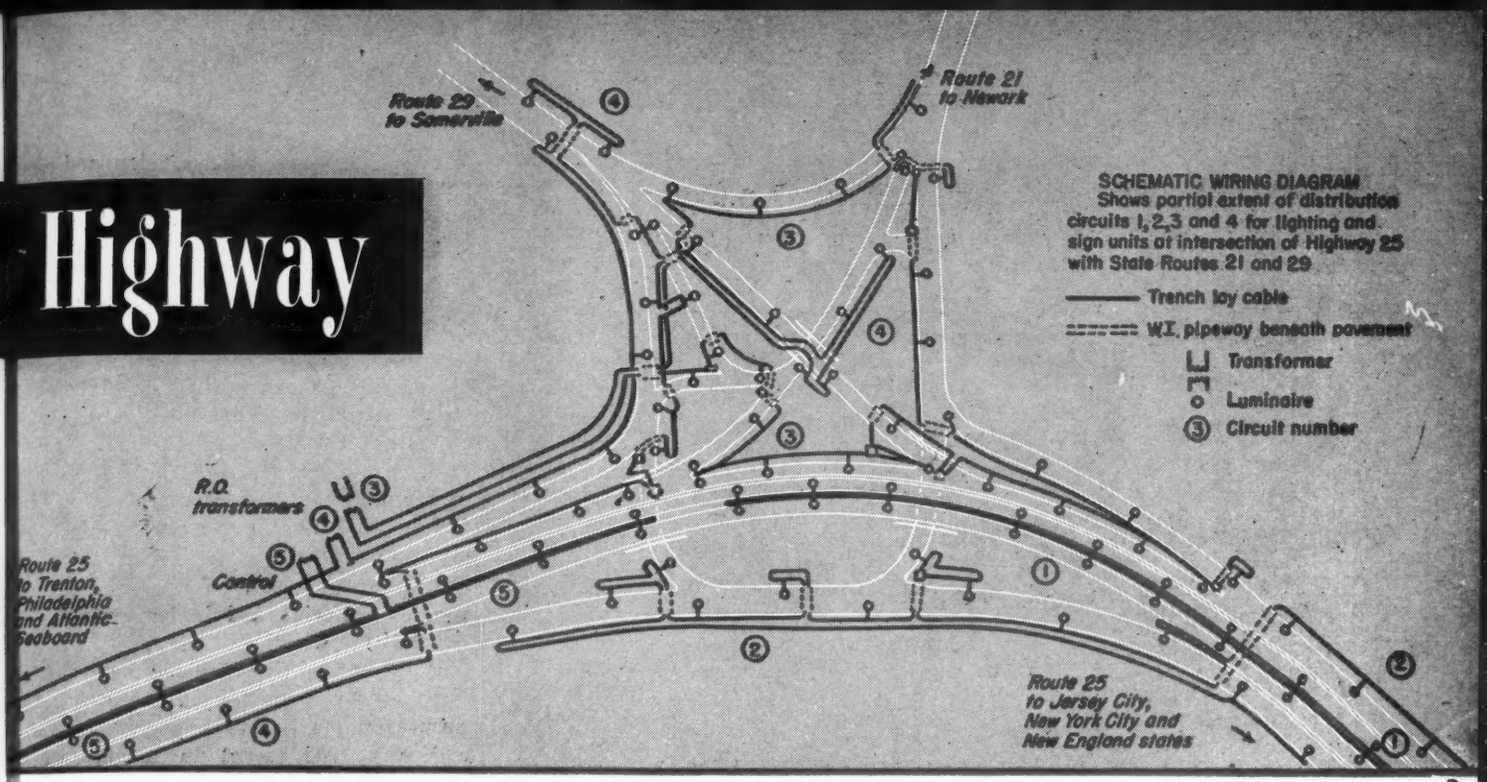
In conformity with I.E.S. Recommended Practice, lighting standards with double mast arms and luminaries are located in the center of the central islands while single-light standards are erected 2-feet 8-inches behind the faces of outside curb lines. Mounting height from pavement at curb to center of light source is 25 feet. Arm lengths are predominantly 12 feet for double units and 15 feet for single lamp standards. Current from two Public Service Corporation of New Jersey networks (Essex and Union Counties) feeds the eleven lighting circuits in this initial installation. Each circuit supplies approximately 35 lamps. Operation of luminaries on these circuits is automatically controlled in conjunction with the urban street lights of Newark (8 circuits) and Elizabeth (3 circuits). From pole-mounted constant-current transformers linking these circuits to the 4150-volt utility networks, No. 8 single-conductor cables descend through conduit with sub-grade sweep-elbow terminals to trench lay distribution systems. An insulating transformer at the base of each lighting standard steps the 7.5 ampere primary current to the 15/20 amp. secondary level. No. 8 single-conductor pole and bracket cable (600 volts) then rises to the luminaires. Trench cable is carried beneath highway lanes and along the supporting girders of overpass bridges through galvanized wrought iron pipe.

Lighting standards are supported on concrete truncated pyramids. Dimensions are 18 inches along the upper sides, 3 feet across the base and 4 feet from crown to base. Galvanized 1-inch anchor bolts, end-hooked and buried in concrete 36 inches, are threaded over a 3-inch protruding length for standard-holding hexagonal nuts. Galvanized sweep ells with bushings at both ends receive trench cable 12 inches below grade, carrying it up into the standards.

LIGHT PROMOTES SAFETY

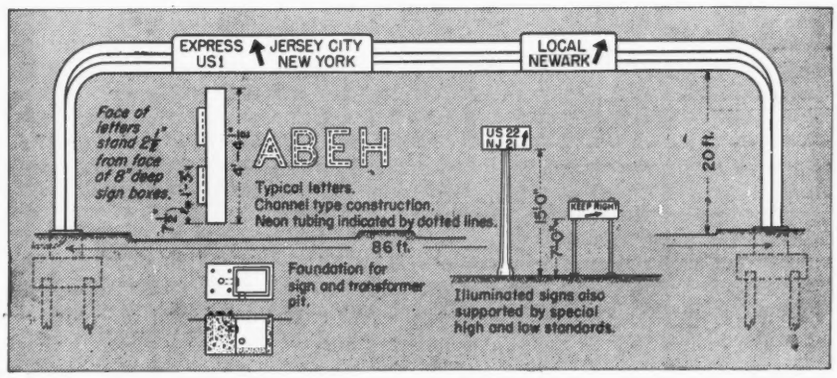
The National Safety Council's report for 1941 (our last pre-war peak-traffic year) recorded 23,000 deaths resulting from highway accidents during hours of darkness—of which an estimated 10,000 were attributed to impaired visibility. A nation-wide 42-city survey revealed the fact that, other factors remaining comparable, fatalities decrease in proportion to the increase of lumens per square foot on highway surfaces. Federal, state and civic thinking recognizes the sound economy of investing public funds to save lives and property. New Jersey's present highway program represents tangible action toward safety through better highway lighting. But this is only the beginning. Appropriations for highway lighting are a disgracefully insignificant proportion of highway budgets. Yet a dollar spent on lighting buys more accident prevention than a dollar spent on any other feature of highway construction.—*Editor.*

t Highway


Route 29 to Somerville
Route 21 to Newark
SCHEMATIC WIRING DIAGRAM
Shows partial extent of distribution circuits 1, 2, 3 and 4 for lighting and sign units at intersection of Highway 25 with State Routes 21 and 29
Trench lay cable
W.I. pipeway beneath pavement
Transformer
Luminaire
Circuit number
R.O. transformers
Control
Route 25 to Trenton, Philadelphia and Atlantic Seaboard
Route 25 to Jersey City, New York City and New England states

Modernization of Route 25 includes construction of eight-lane highway with overpasses at all intersections, IES recommended lighting and illuminated directional signs.

In selecting luminaires and determining the spacing of standards, the objectives of the state highway electrical division were to equal or exceed all I.E.S. Recommended Standards, achieve average pavement illumination above .5 footcandle intensity, concentrate maximum light on the highway and minimize glare from source brightness. Mounting heights of 25 feet, placing light sources well above the normal visual axis, raised luminaires from the blinding area. I.E.S. Type II luminaires with prismatic refractor globes and reflecting shields were specified in order to permit mounting near the outer roadway limits, obtain narrow asymmetric distribution with two strong elongated beams following the axis of the highway, and project most of the reflected light at an approximate 15-degree angle below the horizontal. The luminaire specified has a light, strong, rust-proof die-cast aluminum hood with top-tap for pendant suspension. Alzak aluminum, highly efficient reflectors, constructed with series of offsets or small steps in closely-spaced vertical planes, deflect the rays past the stem of the housed lamps, slightly increasing the light output and freeing the lamp from the destructive heat which otherwise would be concentrated upon it. Spun-sealed globeholder construction, with reflector rim rolled over the lip of the globe, protects glass edges against nicking during maintenance and results in a dust-proof and insect-proof luminaire minus gaskets. Glare at angles near

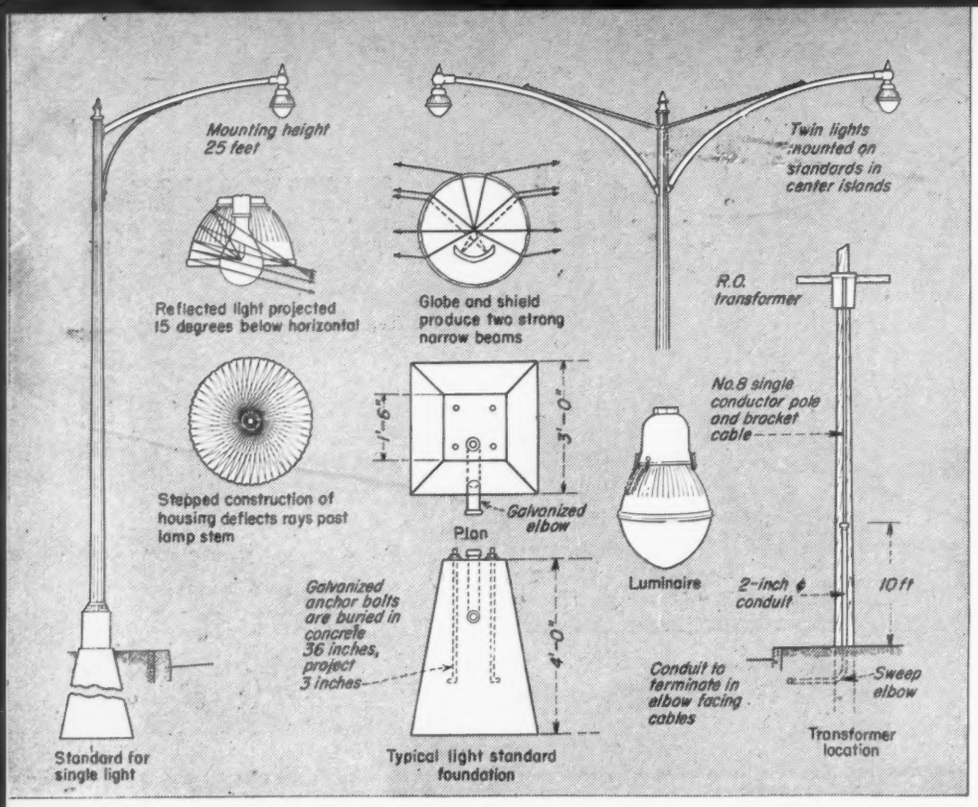

EXPRESS US1
JERSEY CITY NEW YORK
LOCAL NEWARK
Face of letters stand 2" from face of 8" deep sign boxes.
ABEH
Typical letters. Channel type construction. Neon tubing indicated by dotted lines.
US 22 NJ 21
KEEP RIGHT
20 ft.
15'0"
7'0"
86 ft.
Foundation for sign and transformer pit.
Illuminated signs also supported by special high and low standards.

Illuminated signs are mounted on bridge facia beams, special overhead structures or on roadside standards, depending on importance of intersection. White neon tubing in channel type letters are lighted continuously.

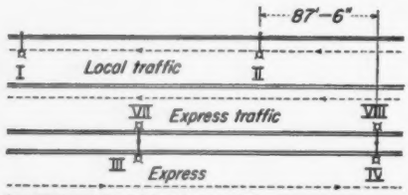
the horizontal is minimized by shading lamp filaments and the resultant optical design provides maximum candlepower at the high angles necessary for uniformity of pavement lighting. The resultant coefficient of utilization is 0.43 on the street side and 0.16 over the shoulders or rear area. Luminaires on twin-lamp standards are fed from two-lamp IL transformers and are equipped with series sockets and receptacles with customary film cut-out, thus maintaining the circuit in the event of failure of one of the lamps. Luminaires on single-lamp standards are fed from standard IL transformers and are fitted with mogul multiple, screw-base sockets.

Luminaires along typical sections of highway contain 6000 lumen PS 40, 20 amp. BU lamps. White light was selected after a study of research data proved that visibility of objects on or relatively close to the pavement is substantially equal with sodium-vapor, mercury-vapor or filament lamps when distributions are similar and intensities equal. Although it was acknowledged that colored lights might better inform motorists of highway directional changes, the relative low degree of curves along Route 25 was not considered sufficiently great to merit a color change for this reason.

With staggered spacing of 87.5 feet between standards, a total overall average intensity of 0.569 footcandles on the highway was achieved. The average intensity along the innermost express lanes is 0.87 footcandles with maximums of 1.15 footcandles directly opposite each twin-light center-island standard. These results exceed by a considerable margin the recommended I.E.S. minimum of 0.3 footcandles for similar highways.


Mounting height 25 feet
Twin lights mounted on standards in center islands
Reflected light projected 15 degrees below horizontal
Globe and shield produce two strong narrow beams
R.O. transformer
No.8 single conductor pole and bracket cable
Stepped construction of housing deflects rays past lamp stem
Galvanized elbow
Plan
Luminaire
2-inch ¢ conduit
10 ft
Galvanized anchor bolts are buried in concrete 36 inches, project 3 inches
Conduit to terminate in elbow facing cables
Sweep elbow
Standard for single light
Typical light standard foundation
Transformer location

Luminaire mounting heights of 25 feet minimize glare by raising light sources above visual axis. Light is asymmetrically distributed in two strong and narrow beams projected at 15 degree angle below the horizontal.



Staggered spacing of units on 87.5-foot centers produces average overall intensities of 0.569 footcandles on roadways. Light components from eight luminaires contribute to total illumination on each section.

In the modernization program, illuminated signs warn motorists of all highway junctions and turnouts. To allow sufficient time for drivers to edge into the proper lanes, to insure visibility during both daylight and darkness and to permit rapid reading, lighted signs are sufficiently high, large and prominent to be seen and understood a safe distance prior to reaching the points of action. Depending upon the importance of the junction, the speed of the lane (express or local) and the number of previous warnings, the signs vary in size, height and prominence. Methods of mounting include overhead structures across the highway, on facia beams of bridges and both high and low separate standards on the shoulders of the roadways. Maximum visibility, speed in reading and beauty of design were desired with minimum obtrusiveness and visual obstruction. In the interest of force and clarity, signs predominantly mention only U. S. highway route numbers and names of major cities, state routes being included only where absolutely essential.

White enameled steel reflectors containing white neon tubing form the letter strokes. Letters conform with standard Public Roads Administration Series D highway sign practice. Establishing lighting practice on the results of lamp-life tests, the signs burn continuously since the slight additional current is offset by the increased life through the elimination of nightly on-off operation. Transformer pits are incorporated in the supporting concrete bases for the standards and structures.

For major route junctions, signs are mounted on overhead steel structures stretching across the highway with a 20-foot clearance.

Northern New Jersey, corridor for the Atlantic Seaboard, has the greatest transportation problem in the world. Heavily industralized and thickly populated (2,753,000 persons in 1,018 square miles), the area straddles the intervening 88 miles separating New York City and Philadelphia (the Nation's first and third largest cities) and includes the Pulaski Skyway and the congested traffic delta fanning out to the George Washington Bridge and the two capacity-crowded tunnels entering Manhattan—Holland and Lincoln. Referred to by the U. S. Bureau of Roads as "the world's most heavily-traveled artery", New Jersey's Route 25 through the Jersey City-Newark-Elizabeth sector carries daily averages of 60,000 vehicles with occasional strangulation peaks exceeding the 102,-000 mark. On the former 4-lane highway, originally designed for 36,000 cars a day, these traffic overloads of 100 and 200 percent have resulted in estimated annual wastes of $5,000,000 due to lost personnel-hours, delayed freight, accidents and higher operational charges.

With no existing suitable detour, New Jersey Highway Commissioner Spencer Miller, Jr., strongly advocated and was instrumental in obtaining legislation and funds for a possible 150 million dollar five-year highway improvement program planned to divert and safely increase the speed of vehicles in this area. The overall plan includes the modernization of Route 25, the construction of a parallel express commercial freeway and a diverting 8-lane arterial passenger-car parkway, free of traffic lights and with grade separations at all waterways, intersections and railway crossings. This greatly-needed, ambitious program, designed under the jurisdiction of State Highway Engineer Charles M. Noble and authorized by the U. S. Public Roads Administrator, will be paid for from New Jersey Highway Users' Taxes (between 40 and 50 million dollars yearly) and grants awarded the State under the Federal Aids Highway Act ($9,400,000 for three years). State legislation has approved an initial expenditure of $16,600,000 for the year ending July 1, 1947.

With multiple express routes dividing cross-state traffic, the anticipated daily vehicular total over Route 25 is predicted to fall to 36,000 by 1950 and rise to 40,000 in 1960.

Fewer cars, added lanes and wider roadways will undoubtedly decrease the number of accidents but there is the possibility that the accidents that do occur will be more serious due to the higher rate of traffic flow. To reduce this possibility to a minimum, good visibility is imperative. Acknowledging this fact and believing that the cost for super highway lighting will be less than losses from accidents caused by insufficient illumination, New Jersey is giving far-sighted attention to good highway lighting.

ELECTRICAL MAINTENANCE Key to Efficiency

Publishing 18 million newspapers a week demands constant service from approximately 3,000 motors. Five rewinds in 17 years is an outstanding tribute to sound electrical maintenance.

By John Peters
Chief Electrician
New York Daily News

PREVENTIVE maintenance — in the fullest meaning of the words —is the primary objective of the electrical department servicing more than 3,000 motors in the Manhattan and Brooklyn plants and garages of the New York Daily News. The proven value of routine inspections, proper regulation, exact control and sound maintenance is indicated by the fact that, during my 17 years of personal experience as chief electrician, only five motors have required replacement due to burnouts. In meeting this metropolitan newspaper's deadline, each press delivers 50,000 copies an hour for the first edition and operates at web speeds over 1600 feet a minute in a grueling production marathon. Performance of equipment must remain unfailingly dependable to meet circulation requirements of 2,275,000 copies daily and 4,750,000 Sunday editions. Since today's newspaper production is built upon an electrical framework, the effectiveness of electrical maintenance is the justification for our department's existence and determines the efficiency of a huge, high production organization.

The diversified activities of The News cover the fields of journalism, printing, photography, engraving, electrotyping and business. This diversity, reflected in terms of electrical equipment, includes calculating machines and conveyors, elevators and electroplating equipment, presses and pumps, signals and solvent recovery apparatus. Ratings start with business machines of 0.05 hp. and run up to a 750 kw. rotary converter in the Brooklyn plant where primary 4150 volt, a-c, 3 phase current is converted to 250 volt d-c for press operation. The largest single classification of motors is for press operation—the two plants containing 92 black press units, 24 rotogravure units and four 8-couple color presses. Each high speed black press unit has seven motors. Complete data for these motors, listed on 6 by 9 inch cards, is filed in the electrician's office. These motor cards list manufacturer, physical dimensions, operational characteristics, hp., location and purpose, past repairs, dates of such repairs and names of the men performing the work. Spare motors are stocked for all important equipment to prevent a major shutdown.

The electrical maintenance department of the New York and Brooklyn plants include 26 union electricians from IBEW Local 3. These men were selected not only for their technical aptitude but for their potential ability to think logically and act cooly in emergencies. After initial assignments on general building maintenance, new men are trained for specific assignments over a period of several months or a year under the guidance and supervision of more experienced men. This training period is an investment towards future years of continued service and as long as the men remain capable of filling their assignment, they are considered permanent employees. Additional training and correction, rather than incriminations or punitive measures, are scheduled for a man making an honest mistake. Emphasis should be placed on the word "honest", however, for we cannot tolerate buck-passing, mis-statements of fact or the costly covering of organizational weaknesses.

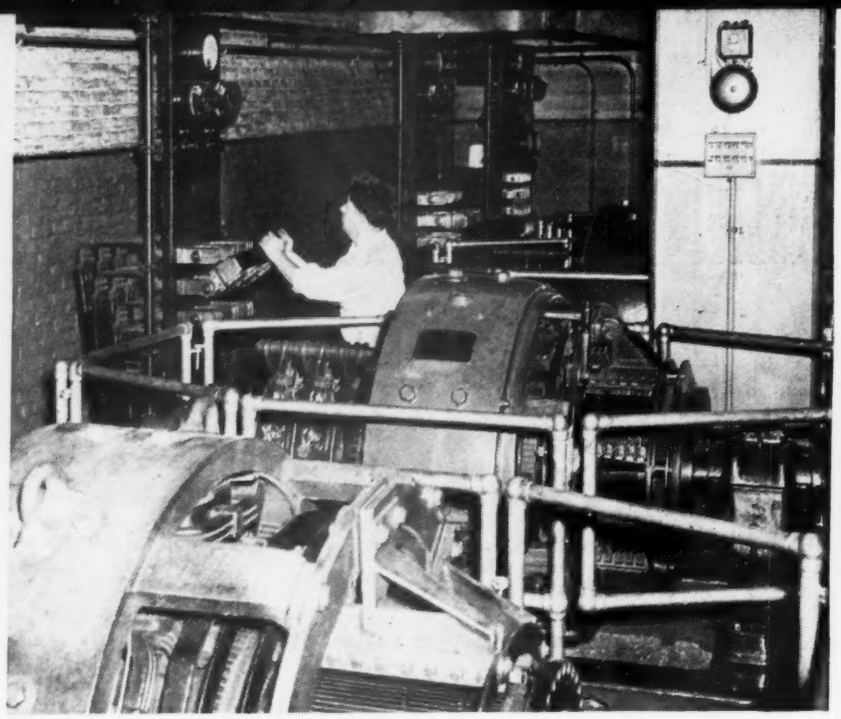
In addition to maintenance work, the department must keep pace with electrical and technical progress. In the past decade this progress has included the installation of new high-speed presses, electronic control in the stereotype department, revamping the rotogravure press arrangement, advances in color reproduction, a partial swing from incandescent to flourescent lighting, and expansion of the distribution system.

With round-the-clock operation, personal contact with each maintenance electrician is not possible but the activity of the men can be supervised through reference to electrical charts (tachometer and tell-tale) and routine reports.

A tachometer chart for each press continuously plots the rate of press operation (translated into copies per hour) against time. Major divisions are in units of 10,000 copies and 10 minute intervals. In operation, the chart is moved forward slightly every

DIVERSITY OF ELECTRICAL EQUIPMENT IN A METROPOLITAN NEWS PLANT

Battery chargers
Blowers—air
Business machines — adding, addressograph, calculating, dictaphones, duplicators, multigraphing, tabulating
Clocks
Compressors—air
Converters—rotary
Conveyors
Drills
Dryers—film, ink, plates, prints
Electroplating equipment
Elevators—freight and passenger
Fans — circulating, drying, exhaust, ventilating
Furnaces—metal melting
Grinders
Heaters—linotype, monotype, tank, water, wax
Heating elements
Hoists—freight, mobile, portable
Lighting — emergency, flood, industrial, office, photography, spot
Linotype machines
Meters
Pasters
Presses—molding, printing, proofing
Pumps—circulating, deep well, fire, sump, vacuum, water
Rollers—matrix, mat
Routers
Saws
Shavers
Signal systems—bells, buzzers, horns
Signs—directional, exit, safety
Solvent recovery equipment
Stereotype equipment
Tension machinery
Transformers
Thermostats
Tools—building, machine
Trimmers
Trucks—delivery, industrial, hoists
Tying machines
Vacuum cleaners



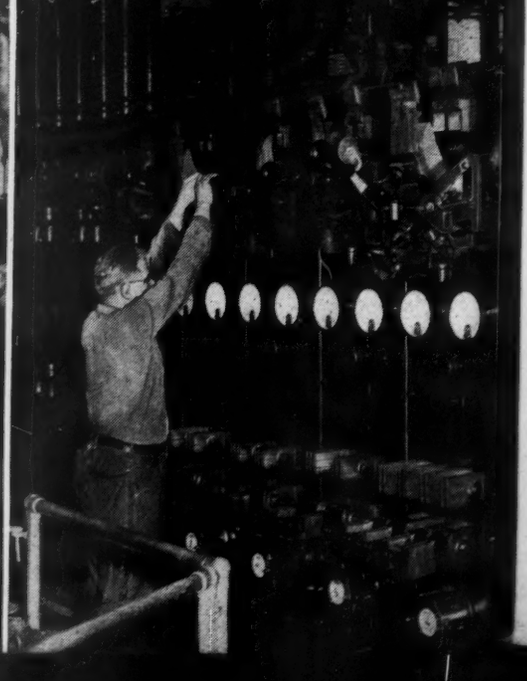
Rotary converters in the Brooklyn plant convert primary 4150 volt a-c, 3 phase current to 250 volt d-c for press operation.

15 seconds so that 40 individual lines are plotted during each 10 minute period. The first or city edition is run off the presses at the rate of 50,000 copies an hour (individual lines on the tachometer chart indicating a 15-second count of 208 copies). Presses are slowed to a 45,000 rate for subsequent editions. The hourly limit of 50,000 copies was established as the point where maximum production could be attained without overloading or straining equipment. Slowing or stoppage of the presses is indicated on the charts by lines shorter than the average or by definite gaps. By reference to these charts, the exact time of each stoppage is fixed, the responsibility for maintenance is instantly established and the cause of the delay can be determined by referring to the emergency reports filed by the maintenance man on duty.

Switchboards and key equipment in locked, caged areas are regularly checked at hourly intervals for possible overloads or faulty operation. Key-operated time clocks at these locations record each inspection on a revolving tell-tale chart in the engineer's office. Clocks are so situated that the inspector must enter the enclosures and circle the equipment on each trip, making cursory inspections improbable.

Electrical maintenance man closes high voltage disconnect switch in transformer room of the Daily News Brooklyn plant. Emphasis is placed on safety as well as on knowledge and thoroughness. Photos by Daily News

Circuit breakers in rotary room are inspected by electrician with responsibility for equipment in this area.



A meter on one of the main a-c boards is systematically checked. The times when these periodic inspections are made are noted on a remote tell-tale chart located in the chief electrician's office.

Daily reports from each maintenance electrician briefly list departments visited, equipment inspected and the scope of work performed. Reports from men answering emergency calls also specify department and machine, adding the time of the call, time of completing the repair or adjustment, nature of the trouble, cause and remedy, general condition of equipment and recommendations for further attention.

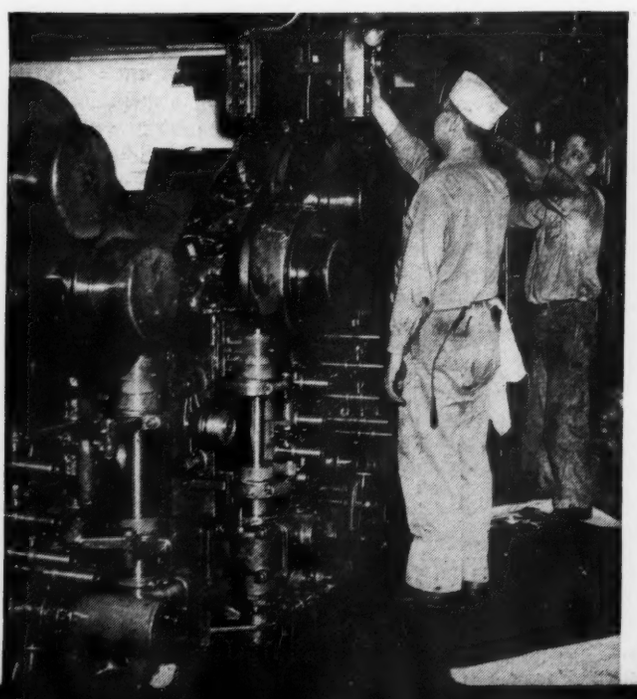
Written or typed verification of all orders, assignments and reports allocates responsibility, reduces the possibility of wrong assumptions, verbal omissions or debate at a later date as to the nature of past trouble, cause, cure and obtained results.

Equipment is inspected, cleaned and oiled on a rigid schedule. Cleaning includes scraping commutators, repairing and replacing contacts, checking and cleaning motor brushes, button stations, limit switches and paper break detectors. Only through technical knowledge and thoroughness of maintenance can the uninterrupted operation of presses be guaranteed.

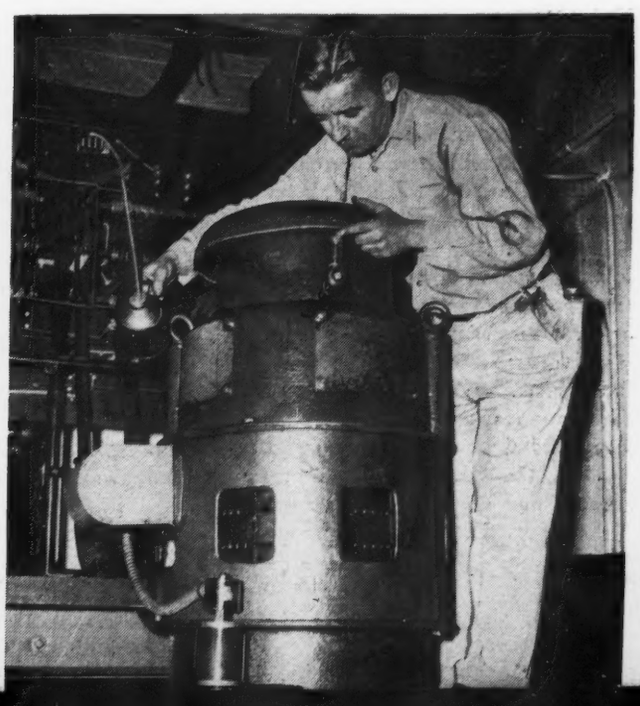
Summarizing the structure and operation of the department: men are selected and trained to cover specific assignments with definite responsibilities, each on-coming shift is given a complete picture of work in progress by the men being relieved, gaps on tachometer charts must be explained by reports, all reports and orders are verified in writing.

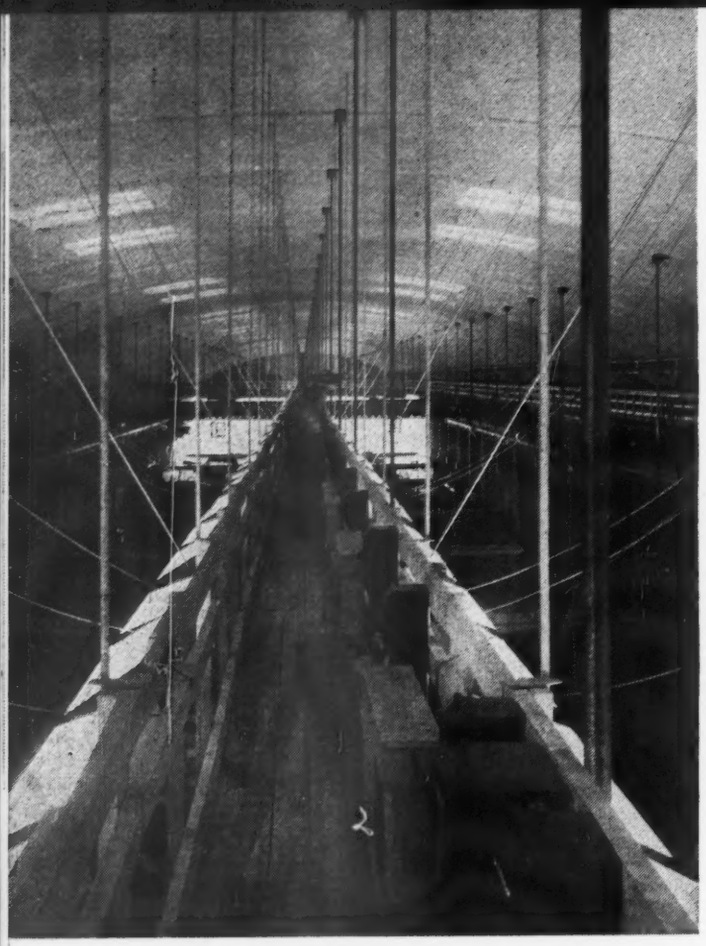
Installation, maintenance and repair of controls, motors, heating elements, signals, lighting and wiring is handled by specialists in these respective fields. With peak operation between 8 p.m. and 5 a.m., the plants cannot rely on assistance from outside sources but must be entirely self-sufficient in all emergencies. The effectiveness of this approach and treatment is testified by a production record second to none.

Equipment in press rooms includes hundreds of motors, reel limit switches, press and tension control stations, tiering machines, lights and signals.



Deep well pump delivers 350 gpm. from a depth of over 100 feet. Circulating, fire, sump and vacuum pumps also require servicing by maintenance men.





View in Edward G. Budd plant, near Philadelphia, showing 3-kw. mercury vapor units alternating with four 751 watt incandescent units, used for indirect lighting. Sketch shows part-section through plant, and relation of lighting equipment to arched ceiling.

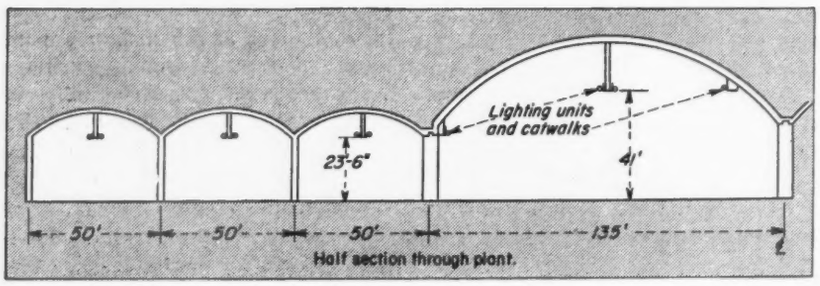
INDUSTRIAL

Part I—

LIGHTING WITH INCANDESCENT LAMPS

First of a series devoted to the selection and application of light sources, lighting equipment, lighting layouts, and electrical distribution systems, to provide better light for production in industrial plants.

By Berlon C. Cooper



PLANNING the lighting for industrial plants has become more complicated. No longer is it a simple problem of selecting the right size incandescent lamp and reflector for the standard outlet spacings so popular a few years ago. It now involves the selection and coordination of many factors. These include light sources, type of lighting system, equipment, spacing and mounting heights or locations, wiring methods and electrical distribution system, color and finish of paints on ceilings, side walls, floors and machines, brightness control and other similar factors.

With the development and refinement of mercury vapor and fluorescent light sources, added to a complete line of incandescent lamps, and a wide variety of types of equipments and electrical distribution systems, lighting systems should now be selected and planned by those who are well informed on all these factors as they relate to vision. This becomes more and more important, as lighting levels are raised, and as competition becomes keener for the products manufactured. Lighting has become truly a *production tool* for industry—an inefficient tool if a poorly designed lighting system is installed, but an efficient and productive tool if the correct quantity and quality of light is carefully planned for the varied seeing problems encountered in the many types and classes of manufacturing processes.

There is today a better understanding of the process of seeing. The trend is toward reduced brightness contrasts, higher levels of illumination (but with less emphasis on mere footcandle designing), selection and control of the color quality of the light needed for different tasks and processes, consideration for ease of maintenance, and selection of light sources, lighting equipment and electrical distribution systems which offer economies in the total cost of light.

Seldom is light associated with the architectural and structural design of industrial plants. Yet in a few instances the lighting system has been integrated with the design, with highly successful results. In these instances lighting equipment or components are combined with the design, or with structural details, to provide an unobtrusive lighting system enhanced by the architectural treatment, or supplementing and accenting the architectural design. This is a field that should be further studied by those well informed in the functional merit of such combinations.

It is an old story that "light permits vision", or "lighting is a seeing aid." Yet those who plan lighting for in-

LIGHTING TECHNIQUES

dustry must keep in mind the four fundamental factors of vision. These are: *size, contrast, brilliance,* and *time.* The *size* of an object or detail to be seen influences the footcandle intensity required. The brightness *contrast* between an object and its background influences the time required to see it clearly. The *brilliance,* or brightness of an object is a result of the amount of illumination falling on it and its reflection factor, and affects the lighting level required. The *time* that is required to focus eyes and produce vision varies with lighting intensities, and also influences the amount of light required to provide for maximum production. Keeping these factors in mind, the economic justification of a good lighting system is made easier.

Increased production and greater safety are perhaps the most important results of good lighting in industry. Many impartial studies have shown that production rises as illumination intensities are increased, to an extent that will in most cases offset the added cost of the improved system. Good lighting also helps to prevent accidents by enabling workers to see quickly and easily, results in better workmanship and decreased rejects, reduces eye strain, makes for better morale and satisfaction among employees, permits full utilization of all floor space, and influences workers to keep the plant clean.

In order to plan good lighting for industry, it is pertinent to know what constitutes a good lighting system. There are three major factors to be considered: quality of light, quantity, and brightness-contrasts.

High bay areas are effectively lighted with intensive distribution type reflectors using standard 750 to 1500 watt incandescent lamps. Reflectors commonly used are specular and semi-diffuse aluminum, prismatic glass and silver mirrored glass. Holophane prismatic glass shown here.

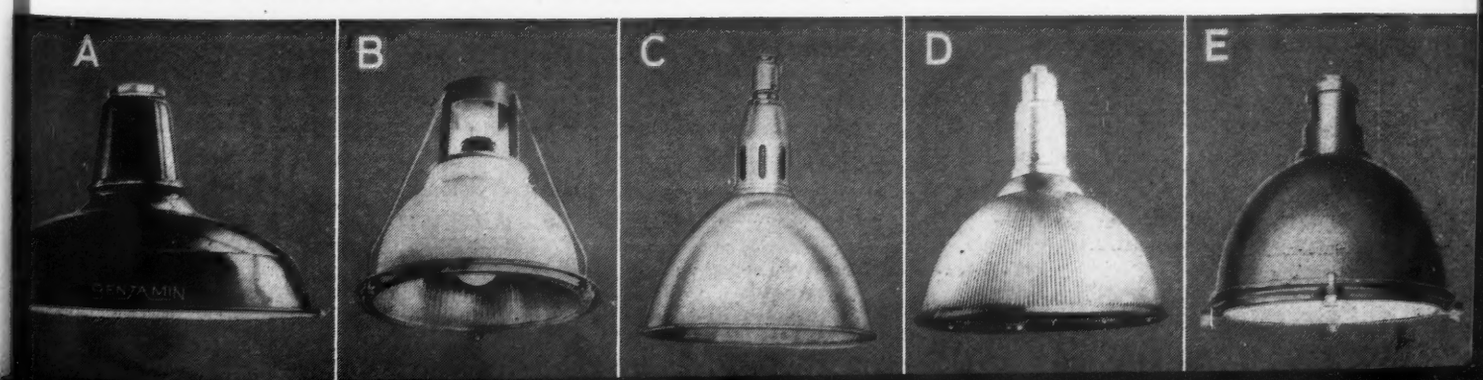
Different seeing tasks in industry require different qualities of light. Seeing tasks for a specific plant must be analyzed and carefully evaluated before planning the lighting system. Where color evaluation is of any importance, the proper light source, or sources, must be selected to provide illumination which has the required color quality for the work involved. Well diffused illumination is important for most industrial areas. Glare, both direct and reflected, should be avoided. Illumination intensities should be maintained as nearly uniform as possible throughout each separate area of a plant.

Quantity of light is measured in footcandles. Recommended intensities for industrial operations are shown in brief form in Table I.

Brightness contrasts must be avoided, as they constitute glare. The intensity on the work and in the normal field of view should be such that, taking into account the reflection factors involved, the brightness of the work does not greatly exceed that of the surround.

The heart of an electrical lighting system is the light source itself. The electrical current may thus be considered to be the blood stream. There are three basic types of light sources which are normally used in industrial

Typical industrial reflectors for incandescent lamps. (A) Porcelain enameled steel reflector (RLM) for diffuse spread; (B) prismatic glass reflector with aluminum cover, medium spread; (C) aluminum high bay reflector, intensive distribution; (D) silver mirrored glass high bay reflector, intensive distribution; (E) dust and vapor-tight unit, interchangeable inner aluminum reflectors, hinged cover. All units except (A) are adaptable for use with 400 watt type H-1 mercury vapor lamps as well as with incandescent lamps.



Here is typical example of the use of local lighting to provide high intensity illumination on fine detail work, supplementing the general lighting. Standard filament lamps in parabolic reflectors do this job efficiently.

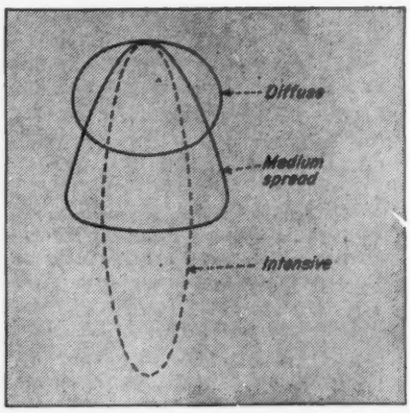
plant lighting; (1) incandescent; (2) fluorescent; and (3) mercury vapor. The lighting techniques applying to each light source vary somewhat due to the physical characteristics of the lamps, and due to the method of control. For the sake of simplicity, each light source will be discussed separately.

The incandescent electric lamp was invented nearly 70 years ago by Thomas A. Edison. Research through the years has been responsible for improvements in this lamp until the theoretical maximum efficiency has been approached to a practical point where very little further progress seems possible, due to practical limitations. The very complete line of incandescent lamps now available meets the usual requirements for lighting in industry. Light output varies from approximately 15 lumens per watt for the smaller standard lamps to 21 lumens per watt for large incandescent lamps. Life ratings are designed for 750 hours of actual burning for the smaller lamps, and for 1000 hours of actual burning for the larger sizes. Lamp schedules, which list the types and sizes of all standard lamps, and give other useful data on each lamp, are available from all lamp manufacturers. Hence, such data will not be discussed further in this article.

Lighting Equipment. Incandescent lamps have a point source of light. This enables accurate control of the light generated, by means of reflectors, refractors and diffusers.

There are three basic types of reflectors for providing general lighting in industrial plants. These are commonly referred to as low bay, medium and high bay types. Metal, glass, paint and plastics are all used as reflectors. Each material has its own advantages, as well as disadvantages. In selecting the reflectors for any specific application, it is the advantages and disadvantages of each which must be considered and carefully analyzed.

High bay reflectors require an intensive or concentrating type of light distribution. Prismatic and silver mirrored glass, and specular or semi-diffuse aluminum are normally used to provide the necessary light control for these high mounting type reflectors.



Reflectors used for general lighting are designed for three types of general light distribution: diffuse, or wide spread for low mounting heights; medium spread for medium mounting heights; and intensive for use in high bay areas.

Medium bay reflectors require a medium spread type of light distribution. Prismatic and silver mirrored glass, and semi-diffuse or diffuse aluminum, with proper design shape, provides this type of distribution. Porcelain enameled steel reflectors are also sometimes used where the mounting height is under 25 feet, and wide spacings exist.

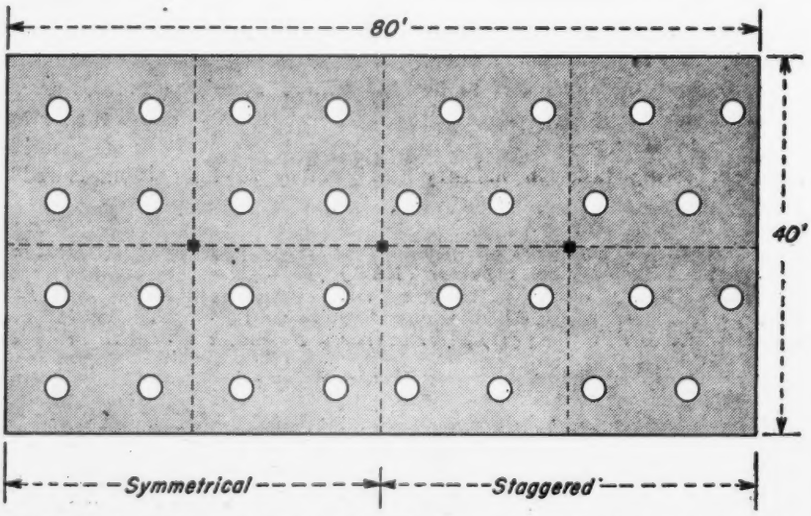
Low bay reflectors are made of porcelain enameled steel, diffuse aluminum, plastics, prismatic glass and silver mirrored glass. For very low wattages, 100 watts and under, aluminum paint and baked-on white paint are sometimes used. Other reflecting materials, such as chromium, rhodium, etc. are sometimes used for special applications.

Reflectors for industrial application should be rugged, have a high reflection value of permanent quality, be easy to clean, and economical in cost. Reflecting qualities should not be damaged by cleaning, heat, or accumulation of dust and dirt.

Special shapes and sizes of reflectors are made for local and special lighting applications. These should meet the same rigid requirements of the larger general lighting type of reflectors.

Light Distribution. Intensive distribution is used in high bay areas generally where the mounting height is above 25 feet. Medium spread distribution is used for mounting heights of 16 to 30 feet, and diffuse distribution is used for mounting heights of 20 feet or less.

[Continued on page 158]



Three basic systems are used for locating incandescent units—symmetrical spacing, staggered spacing, and special spacing for specific lighting of individual machines or operations.

FARM WIRING . . .

An Expanding Market

Rural electrification on the march, its market potential, and how to approach and design farm wiring for today's loads and requirements

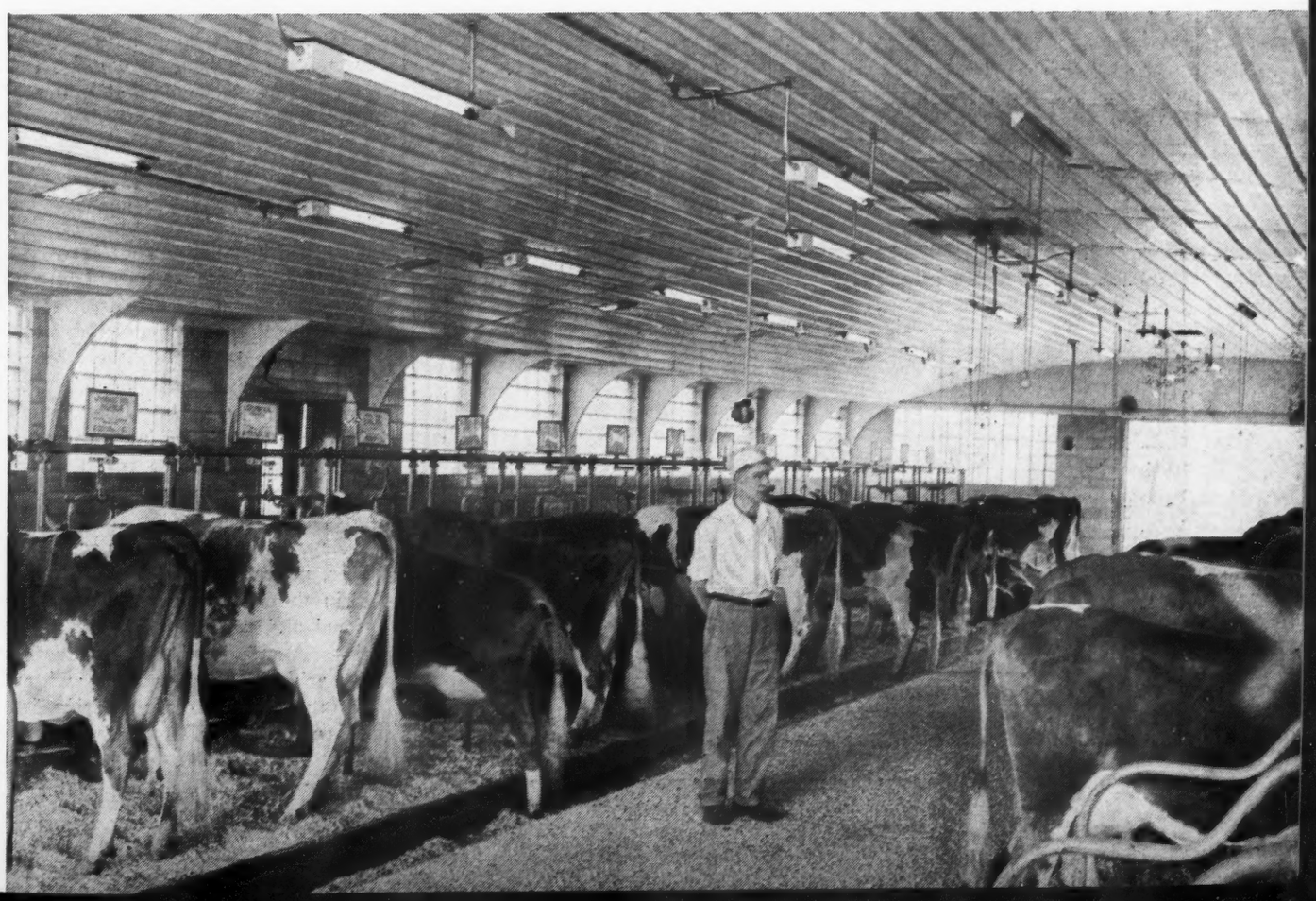
By August Eckel

FARMSTEAD wiring offers a post-war market that contractors cannot afford to underestimate. A billion dollar job awaits them. By the end of 1948, electric service will be available to some 1,200,000 unwired farms bringing the total electrified to an estimated 4,600,000, the practical limit of high line service. Of the remaining inaccessible farms, many will have their own power plants. Kilowatts will be working on almost every occupied farm in the nation.

Adding incentive to the above program is the economic and production revolution that American agriculture is experiencing today. Total number of farms is decreasing; acreage per farm is up; top income is guaranteed through 1948 by the present farm-price program; mortgage burdens are dropping; mechanization is increasing; production is at a peak. Having tasted the fruits of mechanization during the war, a 50 percent boost in output per worker with a resultant jump in net income, farmers are crying for more.

After almost a decade of self-imposed limitation to farm dwellings, rural electrification has graduated to the outbuildings. Contrary to the early concept of essentially a minimum lighting and appliance load, farm wiring now embraces carefully engineered power applications. Kilowatts are now hoisting hay, milking cows, brooding chicks and pigs, pumping water, unloading silage, cleaning dairy barns, grinding feed, shelling corn, keeping

Ultra modern dairy barn at Curtis Candy Farms in northern Illinois features adequate lighting, thermostatically controlled electric heaters and sterilamp installation among other conveniences.



FARM WIRING...

An Expanding Market

TABLE I. Estimate of Rural Consumer Expenditures for Wiring, Plumbing, and Electric Farm and Household Equipment During the Immediate Post-war Period.[1]

	By consumers connected prior to Jan. 1, 1944 [2]	By consumers connected during proposed 5-year [3] construction program	Combined consumer purchases
Expenditures for wiring:			
Farms	102,280,000	397,445,000	499,725,000
Other rural dwellings	170,000,000	82,278,000	252,278,000
Total	272,280,000	479,723,000	752,003,000
Man-years of labor [4]	136,140	239,861	376,001
Expenditures for plumbing:			
Farms	287,662,000	215,854,000	503,516,000
Other rural dwellings	153,000,000	51,424,000	204,424,000
Total	440,662,000	267,278,000	707,940,000
Man-years of labor [4]	220,330	133,639	353,969
Expenditures for electric farm and household equipment:			
Farms	767,100,000	1,096,400,000	1,863,500,000
Other rural dwellings	1,020,000,000	182,840,000	1,202,840,000
Total	1,787,100,000	1,279,240,000	3,066,340,000
Man-years of labor [4]	893,550	639,620	1,533,170
Total of wiring, plumbing, and electric farm and household equipment:			
Total expenditures	2,500,042,000	2,026,251,000	4,526,293,000
Total man-years of labor [4]	1,250,000	1,013,120	2,263,140

[1] Refer to text for basis of expenditure estimates.
[2] Purchases during the 5-year period after materials and manpower have become generally available.
[3] Purchases during the 5-year period following initial connection under the construction program.
[4] Under the assumption that each $2,000 of expenditure involves 1 man-year of direct and indirect labor.

Note: Basis of Electrical Expenditure Estimates (prewar prices)
Newly wired farms—wiring, average of $145 each.
—equipment average of $400 each.
Farms Now Electrified—additional wiring, average of $40 each.
—additional equipment, average of $300 each.
Newly wired nonfarm homes—wiring, average of $90 each
—equipment, average of $200 each.
Nonfarm homes already wired—additional wiring, average of $25 each.
—equipment, average of $150 each.

Source: R. E. A., U. S. Department of Agriculture.

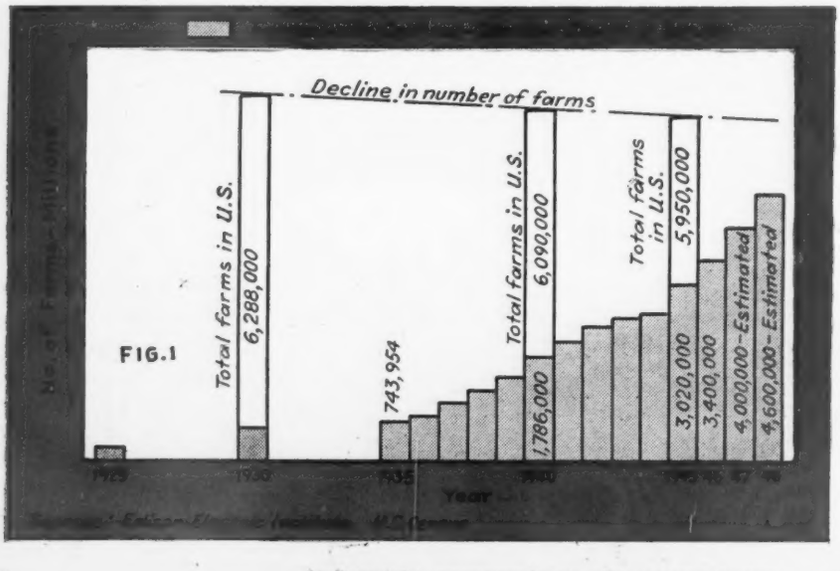


FIG. 1

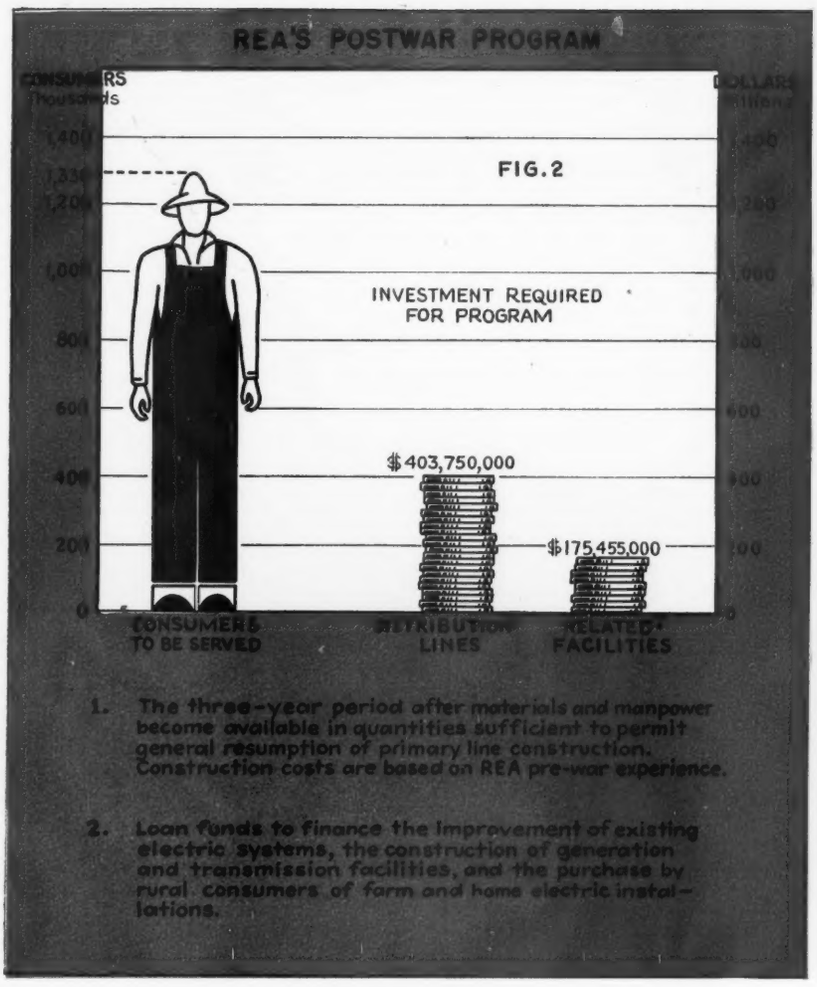
the chickens up late so they lay more eggs, and doing a host of other production boosting jobs. In all, some 300 uses have been found for electricity on the farm and in the home.

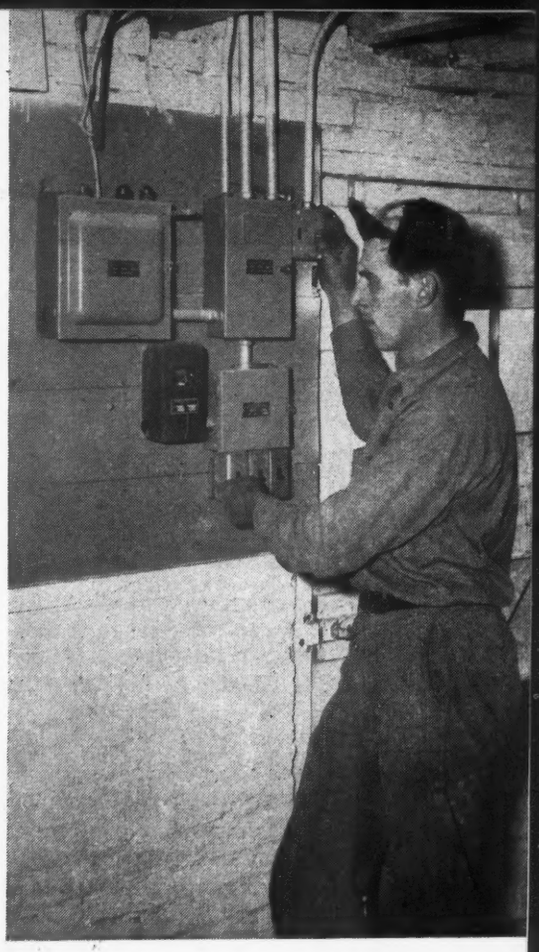
Farm operators are beginning to accept "electro-agriculture" (electricity applied to farm production) as the road to more efficient operation. Those who have already subscribed to this theory know that it works. Data is being compiled on test farms to convince others. Much of the credit for this new thinking goes to the combined research activities of the U. S. Department of Agriculture, university experiment stations, manufacturer and power company rural departments, farm publications, local agricultural and trade groups. Working with each other and the farmer, they have studied his problems and applied electricity to his needs. Indicative of the national scope of this new "awareness" is the formation of the National Electrification Conference in Chicago last year, a group that is planning to study and promote more efficient use of electric power on the nation's farms.

Manufacturers already have designed and marketed low-cost, efficient, safe, approved farm electrical equipment. Aware of the vast market, they are taking an "industrialized" view of farm power problems, and are striving to meet the requirements. As electro-agriculture progresses, more specialized equipment will become available.

The electrical contractor's attitude toward rural wiring, generally speaking, has lagged somewhat behind developments. Entering this field during a depressed farm economy, the average rural contractor was compelled to wire farms on a price basis. The resulting bare-minimum prices meant grossly inadequate installations. General lack of interest in wiring jobs of this type was common in the industry. Despite the reversal of the farm picture and the swing toward mechanization, this contractor attitude still prevails to a serious extent. Unfortunately some firms are still doing farmstead wiring on the questionable "cost-per-outlet" basis with little thought to adequacy or serious planning.

Reports from some farm areas, however, indicate that a shift in thinking is in the offing. Constructive educational and promotional work of local contractor and industry organizations is teaching both contractors and farmers that bare-minimum wiring is an expensive "asset". Experience and


REA'S POSTWAR PROGRAM
FIG.2
INVESTMENT REQUIRED FOR PROGRAM
$403,750,000
$175,455,000
CONSUMERS TO BE SERVED
LINES
FACILITIES
1. The three-year period after materials and manpower become available in quantities sufficient to permit general resumption of primary line construction. Construction costs are based on REA pre-war experience.
2. Loan funds to finance the improvement of existing electric systems, the construction of generation and transmission facilities, and the purchase by rural consumers of farm and home electric installations.



Modern wiring on the farm, representing a higher standard of living for millions, is the work of reputable contractors serving this vast field.

time have proved the false economy of corner-cutting. A large portion of the already wired farms will have to be rewired; REA announced that over half of its co-op lines are unable to handle present consumer requirements and will have to be rebuilt and strengthened. The lessons of the past are bearing fruit and should prevent similar experiences in the future.

Farmstead wiring is at last receiving the engineering approach it requires. The electrical industry's contribution is the recently published Handbook of Farmstead Wiring Design—a treatise on how to *plan* farm wiring. REA is now advising its present and prospective consumers to *make a wiring plan, have a reputable wiring contractor do the work and have the wiring inspected.*

The Rural Market Potential

Four distinct segments comprise the rural wiring market of the future. Each presents its own field of development. Combined they offer a market approaching the billion dollar mark. Based on available statistics, the following breakdown indicates the job to be done:

1. *Unwired Farms*—The estimated 1,200,000 farms to be served and connected within the next two years will require $174,000,000 in wiring. This is based on REA's prediction of an average expenditure of $145 per farm based on prewar costs. At current prices this volume will approach $234,900,000.

2. *Farms Not Connected*—At present some 700,000 farms within ¼-mile of an existing high line, for unestablished reasons, have not taken electric service. At the prewar $145 figure, this would be a potential $101,500,000 market, or $137,025,000 at existing costs.

3. *Added Wiring*—The 2,557,000 farms connected prior to 1944 all are in need of some additional wiring. REA predicts an average expenditure of $40 per farm for this work, or a volume (at prewar costs) of $102,280,000 which may approach $138,078,000 at present levels.

4. *Rural Nonfarm Consumers* — Some 6,800,000 rural nonfarm dwellings already electrified will spend an average of $25 per unit for additional wiring, according to REA estimates. This $170,000,000 volume will probably reach $229,500,000 at today's prices.

Assuming that the 1,200,000 farms to be connected represents 75 percent of the consumers reached by these proposed high line extensions, there will be about 400,000 nonfarm dwellings getting electric service. REA's estimated average expenditure of $90 for new wiring for these units would mean a prewar base volume of $36,000,000 or $48,600,000 at current costs.

Estimates of immediate postwar rural consumer expenditures for wiring and electrical equipment are shown in Table I. With prospects of again reaching prewar construction price levels within the span of this program quite remote, the adjusted volumes mentioned will probably present the more logical picture. The same is true of the boxcar figures portraying the expenditures for electrical equipment. What the probable equipment prices will be in the next three years cannot be accurately predicted now. A great deal depends on what productive capacity and a buyers' market reaction

FARM WIRING...

An Expanding Market

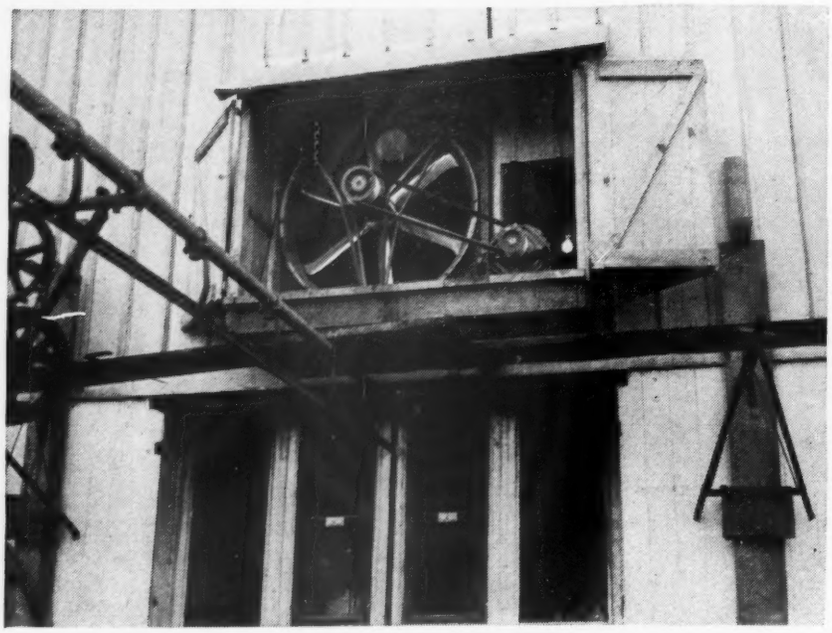
will do. In any event the figure in Table I will undoubtedly be adjusted upward approximately 25 to 30 percent.

REA's postwar-base equipment purchase figures were developed on the assumption that the newly wired farms each will spend an average of $400; existing electrified farms, $400; newly wired nonfarm dwellings, $200; nonfarm units already wired, $150.

Modern farm electrification embodies two distinct wiring systems: (1) The farm residence; and (2) service and distribution to and wiring of the outbuildings or "production areas." Practical electrical applications to each are numerous. Among those listed in Tables III and IV, many will fit the average farm operation. Economies effected by the more common ones are outlined in Table V. Electrical equipment that will find a ready market in the rural and farm areas is listed in Table VI.

Data such as that above indicate the potential of applied electricity on the farm. That past neglect of the "production" phase has left its mark is indicated in Table II. By 1943 only 25 percent of wired farms had electric brooders, water pumps or motors. Promotion was directed to household wiring and appliances.

Concentration on the present concept of "industrializing the farm" will correct these inequities of the past, give the farmer a definite return on his electrical investment—productonwise, bring to fruition the *complete farm electrification* program. Agricultural and electrical industry groups are now working toward this goal. But, only through active cooperation of the electrical contractor—who installs and maintains the system—can ultimate success be attained. Retention of past attitudes may lead to a lot of wired farm homes, but the farmer will still be without kilowatts to do his production chores.



Standard equipment housed in weatherproof enclosure cures hay on this Illinois Farm.

Best assurance that *complete* electrification of individual farms will be realized lies in the use of a realistic contractor sales approach based on a thorough understanding of the farmer's production and economic problems. Practical wiring "know-how" must be supplemented with up-to-the-minute knowledge of agricultural developments. Easiest way to develop this approach is to:

1. Study reports of local, university, and governmental agricultural departments. Many of these reflect mechanization trends and technological advances.

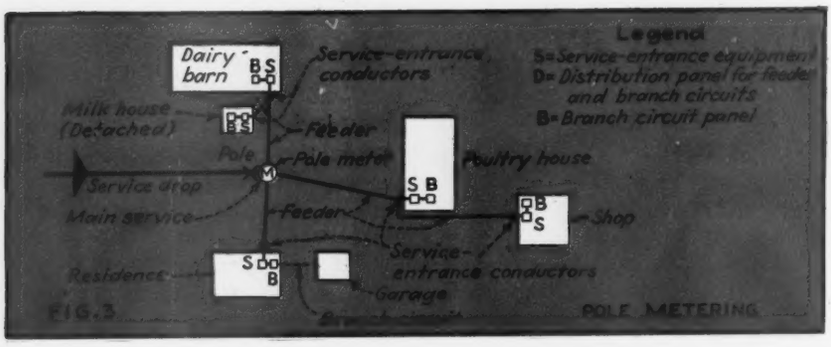
2. Study the latest developments in farm electrical equipment and wiring practices as released by manufacturers, power companies and other groups.

3. Accept and use the advice and help offered by local contractor and industry groups.

4. View farm wiring in its true perspective—as a specialized field demanding competent engineering and layout that will provide safe, adequate, flexible, reliable electric service. Drive home the economic fallacy of sacrificing any of these features to favor first cost.

5. Talk of the farmer's langauge. Translate electrical phraseology into production terms; emphasize production economies; develop comparative cost analyses on specific application problems.

6. Discard the "low-cost" label attached to farm wiring. Design and sell wiring systems on the basis of utilization, production returns, reliabilty, flexibility and adequacy for present and future requirements. Farm wiring should be viewed as a long-term investment with first cost a secondary consideration carefully weighed against operating economy and production increases.



Farm Wiring Design

No electrical equipment will operate efficiently unless backed by a good wiring system. And the farmer will not get the most out of his electrical system—productionwise—unless it has

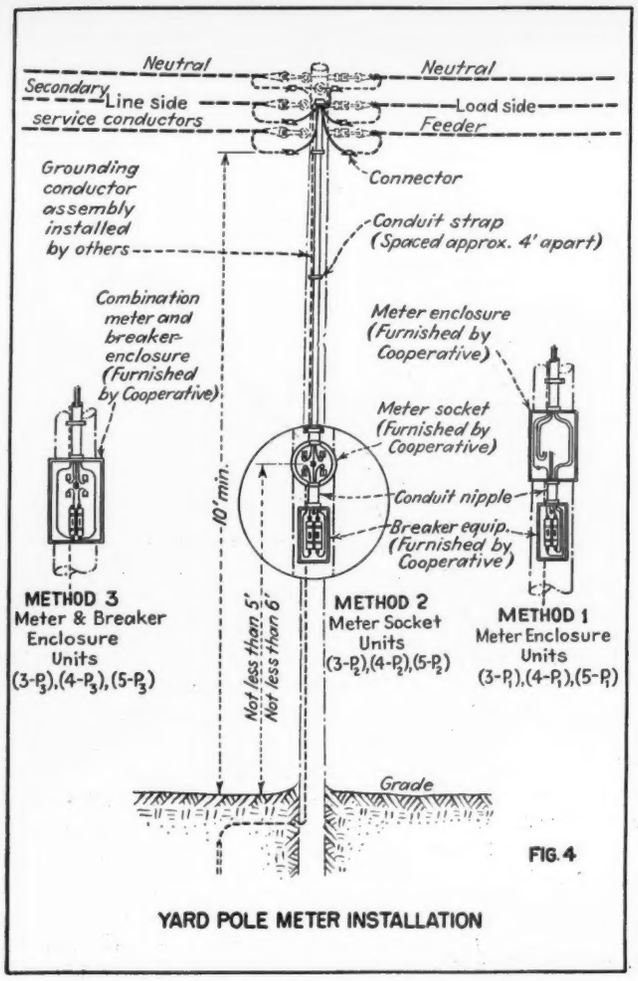


FIG. 4

YARD POLE METER INSTALLATION

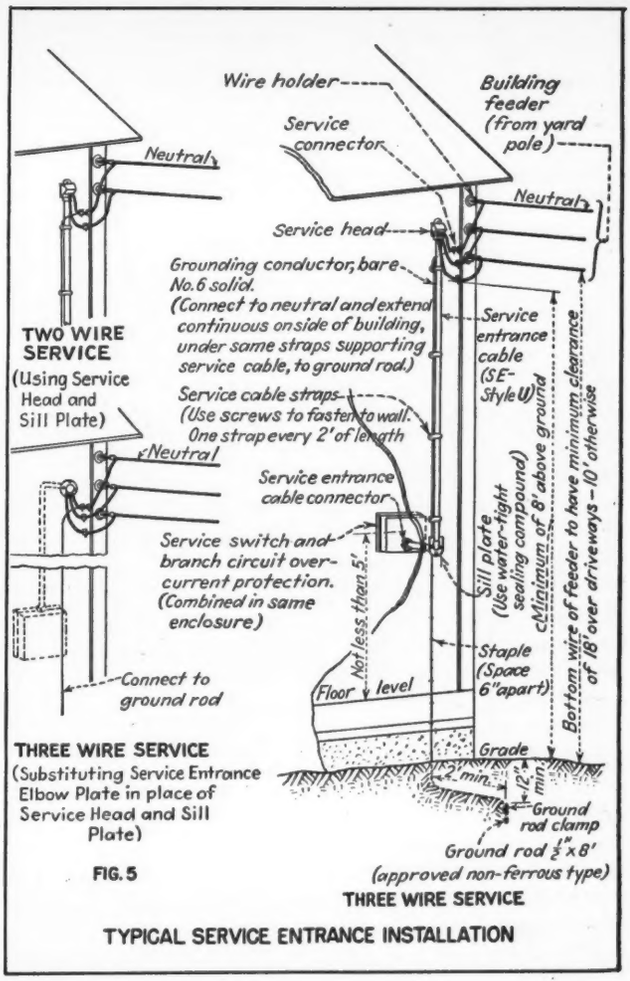
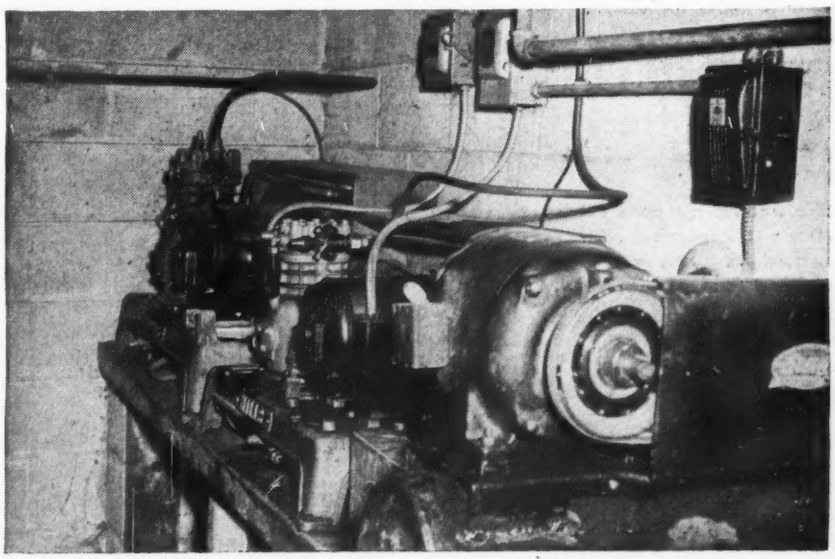

Wire holder
Building feeder (from yard pole)
Service connector
Neutral
Neutral
Service head
Grounding conductor, bare No. 6 solid. (Connect to neutral and extend continuous on side of building, under same straps supporting service cable, to ground rod.)
Service entrance cable (SE-Style U)
TWO WIRE SERVICE
(Using Service Head and Sill Plate)
Service cable straps (Use screws to fasten to wall. One strap every 2' of length
Neutral
Service entrance cable connector
Service switch and branch circuit over-current protection. (Combined in same enclosure)
Sill plate (Use water-tight sealing compound)
Minimum of 8' above ground
Bottom wire of feeder to have minimum clearance of 18' over driveways - 10' otherwise
Not less than 5'
Staple (Space 6" apart)
Floor level
Connect to ground rod
Grade
12" min.
Ground rod clamp
Ground rod ½" x 8' (approved non-ferrous type)
THREE WIRE SERVICE
(Substituting Service Entrance Elbow Plate in place of Service Head and Sill Plate)
THREE WIRE SERVICE

FIG. 5

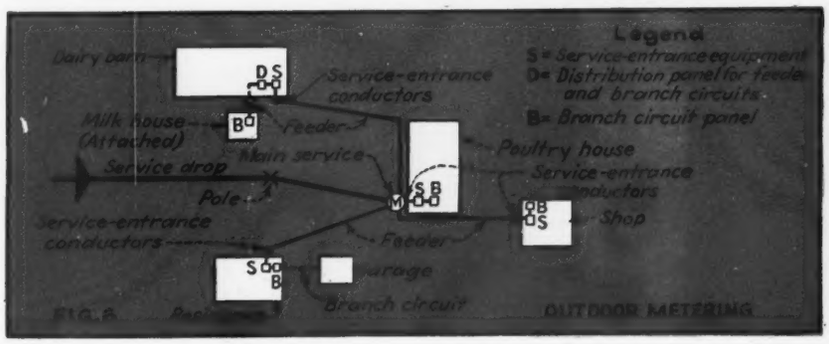
TYPICAL SERVICE ENTRANCE INSTALLATION

been planned to serve his immediate and future needs. To assure fundamental standards, the electrical industry, in collaboration with leading agricultural authorities, developed the previously mentioned Handbook of Farmstead Wiring Design published by the Industry Committee on Interior Wiring in 1946. Contractors who follow the recommendations made therein will give the farmer an efficient, adequate, reliable electrical system.

Complete farmstead wiring embodies outdoor distribution to and interior wiring of the several farm structures. It must be designed and planned to fit individual needs the same as any industrial or commercial system. Each farm structure is treated as a specific production area with its electrical load based on present and anticipated requirements. Table VIII is a helpful guide for estimating and planning such building loads. The wiring diagrams illustrated herein suggest recommended outlet locations. Taken from the above mentioned Handbook these may well become standard practice. Some idea of farm motor loads is given in Table IV. In any well planned system, careful consideration must be given branch circuits serving special purpose outlets or equipment. Table XI typifies



Compressor units in a farm milkhouse operate a milk cooler, meat storage compartment and automatic pipe-line milking system.



FARM WIRING...

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those encountered in the farm home and workshop. Table VIII lists those applicable to outbuildings.

Service Recommendations

Farm building loads will vary with the size of the structure and electrical equipment installed. Past experience has indicated they are in the order of those shown in Table IX together with the probable demands. Service equipment requirements for different sizes and types of farm buildings are noted in Tables VII and X. Services should be designed to accommodate actual and anticipated connected load. However, where future requirements cannot be readily determined, adherence to these recommendations will insure adequacy.

Outdoor Distribution

Individual building loads determine the size of feeder serving the structure. Conductors should be heavy enough to carry the probable maximum demand within *two percent voltage drop*. The one exception to this general rule is the case of service to heating and lighting equipment on which some life process depends. *Feeders to poultry brooders, incubators, ultraviolet lighting and similar equipment should be designed on the basis of a one percent voltage drop.*

The size of service conductors from the utility transformer to the yard pole or central distribution point on the farm is based on the combined loads of the various buildings and the diversity in maximum demands that will exist between buildings.

Most influential factor affecting overhead distribution design is the location of the electric meter. Whether it is on a yard pole or the outside or inside of one of the buildings depends on local utility regulations, the electrical load center or how widely the farm buildings are scattered. Each location has its advantages and disadvantages from the standpoint of copper economy and flexibility.

Pole Metering—This method is generally recommended for farm wiring systems. With the yard pole located near the ultimate electrical load center (Fig. 3), this design has the following economy and flexibility features:

1. Size of *feeders* from pole to various buildings will be smaller than for any other meter location.
2. Since there will be a diversity in demand between buildings, the size of the *service conductors* need not be based entirely on the connected load (installed or contemplated)—hence can be smaller. Probable demands for farm buildings are listed in Table IX.
3. Changes can be made to feeders or wiring in one building without disturbing others or the metering equipment.
4. Loss of one building by fire, or an outage on a feeder, will not interrupt service to other units, a particularly important factor when a pump house is fed directly from pole.

The type of meter equipment installed depends on the local utility practice. Either an outdoor socket-type unit with a disconnect below; a meter enclosure and disconnect, or a combination meter and disconnect enclosure may be used. REA standard practice for pole metering and farm building service is illustrated in Figs. 4 and 5.

Outdoor Metering—Involving the use of more feeder copper, this method is recommended only where local utility regulations or farm building locations preclude yard pole metering. Generally, the meter is mounted on the outside of a farm building nearest the electrical load center (Fig. 6) with feeders branching out to other structures, by one of two methods: (1) multiple feeder risers to overhead spans serving the buildings or (2) a single feeder to a central pole which serves the other units. This latter feeder must be the same size as incoming service conductors.

Indoor Metering—This is not recommended for farms having numerous outbuildings or a sizable electrical load. It is installed primarily where the greatest load is concentrated in a single building with only minor 2-wire, 115 volt circuits to a few other units. Generally it is applied to smaller farms with essentially a household load (Figs. 7 and 8).

Control equipment installation at outdoor meter locations depends upon local utility or co-op regulations. Theoretically it is unnecessary since each building has its own service equipment and overload protection. It is good engineering practice, however, to have an unfused switch (that can be locked) at the meter location for emergency use.

Underground distribution to structures is by no means prohibited, except perhaps by cost, in farm wiring. Some farmers prefer this because they feel it lessens the chance of a lightning outage. The wisdom of this is questionable and would not, in itself, justify the additional investment. Biggest objection is the difficulty of increasing feeder capacity if necessary at a future date; or of locating and clearing any grounds that might occur in the underground section.

Overhead, yard pole distribution is the most economical and flexible method. With the pole generally centrally located with respect to the various farm buildings it affords a good mounting for the yard lighting fixture.

Silo unloader scoops preset amount of silage to center of silo. Feed is then sucked into and blown down shoot to waiting feed cart in yard.

Special Considerations

Farm wiring is generally designed for either 2-wire 115 volt-single, or 3 wire, 115/230 volt, single-phase service. The latter is not only more economical from the standpoint of capacity and service but is necessary where any motor ½ hp. and larger is to be used.

The farmer's greatest electrical asset for most yard chores is the portable

general purpose motor. With it he can hoist hay, cut wood, fill the silo, mix concrete or do a host of other chores. Every planned farm wiring system needs a number of heavy duty outlets to facilitate such use. All motors are to be properly grounded and equipped with overload and undervoltage protection.

Grounding

Good grounding is vitally important. Unlike urban areas, the farm has no underground waterpiping network to offer good ground connections. REA specifications, local utility and code rules and the National Electrical Code (section 2524, 1947 edition) make in-

TABLE II. Estimated Amount and Value of Major Electrical Equipment on United States Farms, 1943

Kind	Percent of farms having electricity	Units	Average value per unit	Total value
HOME APPLIANCES:		Number		
Radios	90	2,208,690	$40.00	$88,347,600
Irons	85	2,085,985	4.00	8,343,940
Washing machines	55	1,349,755	75.00	101,231,625
Refrigerators	40	981,640	150.00	147,246,000
Toasters	30	736,230	5.00	3,681,150
Vacuum cleaners	20	490,820	60.00	29,449,200
Hot plates	15	368,115	2.50	920,287
Coffee makers	9	220,869	4.50	993,910
Electric ranges	4	98,164	130.00	12,761,320
Roasters	2	49,082	24.00	1,177,968
				394,153,000
FARM EQUIPMENT:				
Brooders	25	613,525	25.00	15,338,125
Water pumps and installation	25	613,525	135.00	82,825,875
Electric motors	20	490,820	25.00	12,270,500
Cream separators	15	368,115	125.00	46,014,375
Milking machines	10	245,410	175.00	42,946,750
Milk coolers	7	171,787	165.00	28,344,855
Poultry water warmers	2	49,082	3.50	171,787
Dairy water warmers	1	24,541	35.00	858,935
Feed grinders	1	24,541	75.00	1,840,575
				230,611,777
Total investment in major home and farm equipment in use on farms	.....	.....	.....	624,764,778

Source: R. E. A., U. S. Dept. of Agriculture

TABLE III. Electrical Home Equipment and Power Load

Equipment	KWH Consumption
Clock	2 per month
Coffee Percolator	5 per month
Dish Washer	2½ per month
Fan (household)	2 per month
Fan (kitchen)	8 per month
Freezer	125 per month (per 20 cu. ft. box)
Heater (glowing or radiant)	1 per hour of use
Heating Pad	½ per hour of use
House Heating (oil burner)	25 per month
Iron (hand)	5 per month
Ironing Machine	10 per month
Lighting	20 per month
Radio	8 per month
Range	100 per month
Refrigerator	25 to 30 per month (for 8 cu. ft. box)
Roaster	40 per month
Sewing Machine	½ per month
Toaster	3 per month
Vacuum Cleaner	2 per month
Waffle Iron	2 per month
Washing Machine	3 per month
Water Heater	240 per month

Source: U. S. Department of Agriculture.

TABLE IV. Electrical Farm Equipment and Power Load

Equipment	Rating	KWH Consumption
Barn Ventilator	1/4 hp.	2½ per cow per month (variable)
Bottle Washer	1/4 hp.	½ per 1,000 bottles
Brooder	1 kw.	½ to 3 per chick raised
Churn	1/6 hp.	1½ per 100 lbs. of butter
Clipper (for horse or cow)	1/10 hp. or less	1/10 per hour
Concrete Mixer	½ or 1/3 hp.	½ per cu. yd. of concrete
Corn Husker-Shredder	3 to 5 hp.	30 per 100 bu. of corn husked
Corn Sheller	1/3 to 2	1 per 30 bu. shelled corn (variable)
Cream Separator	1/4 hp.	½ per 1,000 lbs. of milk
Dairy Water Heater	2 to 3 kw.	1 per 5 gallons of hot water (145° F.)
Ensilage Cutter	5 to 7½ hp.	1 per ton
Electric Fence	10-watts	7 per month
Fly Screen or Trap		5 per month
Grain Elevator		4 per 1,000 bu.
Grain Grinder	1 to 7½ hp.	½ per 100 bu.
Grain, Seed Cleaner and Grader	1/4 to 1/3 hp.	1 per 100 bu.
Green Feed Cutter and Root Shredder	1 to 5 hp.	2 per ton
Hay Baler	5 or 7½ hp.	2½ per ton
Hay Hoist	2 to 5 hp.	1/3 per ton
Hay Curing	1 to 7½ hp.	40 per ton of dry hay (variable)
Hotbed	440 watts per 3' × 6' bed or 60 ft. of cable	1 per sq. yd. per day
Incubator	1 kw. and larger	1 per 25 eggs set
Irrigation (surface)	variable	3 to raise an acre-foot of water 1 ft.
Milking Machine (portable)	Up to ¼ hp.	1½ per cow per month
Milking Machine (pipe line)	1/3 to 3 hp.	2½ per cow per month
Milk Cooler	¼ to 3/4 hp.	30 per 10 gals. milk daily, per month
Paint Sprayer	Portable 1/10 hp. Stationary—up to ½ hp.	1½ per 1,000 sq. feet
PoultryHouse Lighting	Variable	5 per 100 birds per month
Poultry Water Warmer	Up to 500 watts	1 per day
Sheep Shearer	1/10 to ¼ hp.	2 to shear 100 sheep
Straw Cutter	1 to 5 hp.	2 per ton
Threshing Machine	7½ hp.	1 per 8 bu. of grain
Tool Grinder	¼ to 1/3 hp.	½ per hour of use
Ultraviolet Lights for Poultry	300-watts per 600 cu. ft. space	7 per 100 hens per mo.
Utility Motor	Small ¼ hp.	½ per hour of use
Utility Motor	Large 3 to 5 hp.	1 per hp. per hour of use
Water Pump (deep well)		1½ per 1,000 gals.
Water Pump (shallow well)	¼ to ½ hp.	1 per 1,000 gals.
Wood Saw	1 to 5 hp.	2 per cord of wood

Source: U. S. Department of Agriculture Westinghouse Electric Corp.

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TABLE V. Electricity Saves Time —Increases Production

FARM HOME*

Appliance	Yearly Savings
Washer (Compared with hand washing an average of 37 lbs. dry clothes per week)	48 hours
Ironer (Compared with a sadiron; average washing of 37 lbs. dry clothes per week)	88 hours
Range (Based on time saved in care and cleaning compared with a coal range)	112 hours
Electric Water System (Based on 3 hrs. 7 min. spent weekly carrying water)	224 hours
Vacuum Cleaner (Compared with hand cleaning methods)	52–256 hours
Electric Hand Iron (Compared with old fashioned sadiron)	80 hours
Refrigerator (Time saved in carrying, storing, removing foods and cleaning time compared with use of a cellar house)	68 hours**

FARM PRODUCTION

Electric Pig Brooder (Purdue University)	Saves 1½ pigs per litter
Hay Drier (Virginia Polytechnic Institute)	Increases value $5–$10 per ton
Poultry House Lighting And Water Warming (Oregon State College and University of Illinois)	Increases egg production 11 to 19½ percent
Electric Water System (University of Minnesota)	Increases milk production 5 to 10 percent
Electric Milking Machine (U. S. Dept. of Agriculture)	Saves 684 hours annually
Electric Milk Cooler (On farm cooling four 10-gal. cans per day)	Saves $4–$5 per month
Garden Watering—1" per wk. (Clemson Agricultural College)	Increases production 2 or more times

** Data by School of Economics, Purdue University.*
*** Actual case study on farms by Monogahela West Penn Public Service Co.*
Information from Westinghouse Electric Corp.

dividual driven grounds at each building mandatory. Both system and equipment ground conductors are connected to these rods. Opinion varies concerning the advisability of connecting farm water systems to these electrodes. REA, following the NEC, permits this. Some areas find this objectionable from the standpoint of transformer breakdowns killing animals at drinking cups. The Minnesota Farmstead Wiring Regulations specifically prohibit this, stating that "Grounds should not be attached to or driven within 4 feet of water pipes or other metallic conducting mediums; otherwise ground rods should be driven as close as practicable to poles or building walls." On milking machines with direct connected motors, Minnesota Authorities recommend a 3-inch all-rubber hose connection in

Motor-driven barn cleaner is a big time saver on dairy farms. Wooden paddles on endless link chain circulates through gutters sweeping them clean; drops manure on conveyor leading to outdoor carrier buckets.

TABLE VI. Electrical Equipment to Sell the Farmer

HOUSEHOLD

Clocks	Ironing machines	Radios
Dish washing machines	Kitchens, complete	Ranges
Electric roasters	Lamps	Refrigerators
Fans	Lighting fixtures	Toasters
Frozen food storage cabinet or space in regular refrigerator	Meat grinders	Vacuum cleaners
	Mixers	Washing machines
	Percolators, coffee makers	Water heater
Irons	Radiant heaters	Waffle iron

PRIMARY PRODUCTION

Brooders, poultry	Grindstone	Pig brooders
Cream separators	Hammermill	Portable motors
Dairy water heaters	Hay hoist	Seed cleaning
Elevators	Lighting	Soldering iron
Fanning mills	Milk cooling	Tank heaters
Feed grinders	Milking machines	Water system

ADDITIONAL PRODUCTION

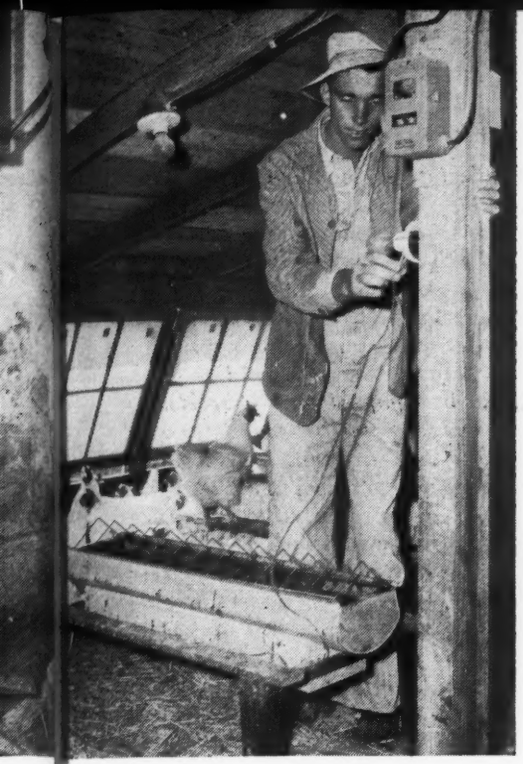
Automatic time switch	Feed mixers	Pumps
Conveyors	Fire alarms, automatic	Refrigeration
Corn driers	Flood lighting	Root cutters
Egg candling	Hay curing	Seed Dryers
Egg graders	Hay cutters	Sheep shearing
Electrified fence	Immersion heaters	Silo filling
Ensilage cutters	Incubators	Soil heating
Fans	Insect traps	Soil sterilizers

CONSTRUCTION AND REPAIR

Battery chargers	Hack saws	Pumps
Concrete mixers	Hot plate	Saws, large & small
Conveyors	Lathes	Soldering irons
Electric tools	Paint sprayer	Small air compressor
Emery wheels	Planers	Welding machines
Forge blowers	Portable motors	

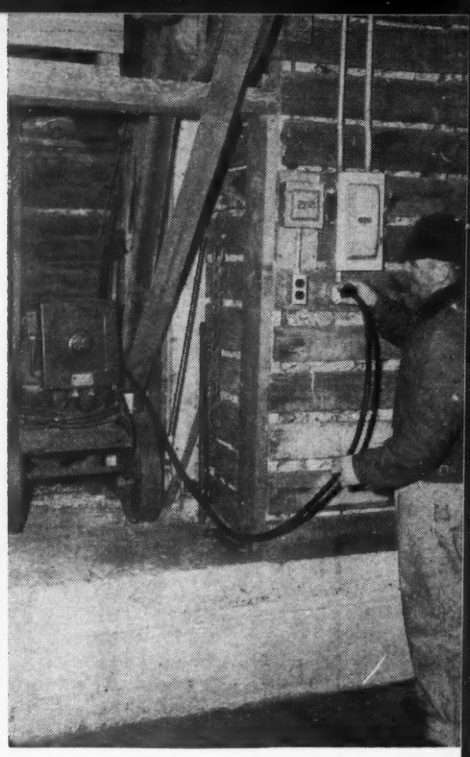
PRIMARY DAIRY

Cream separators	Hammermills	Milking machines
Electri.ed fence	Hay hoists	Pasteurizers
Ensilage machine	Immersion heaters	Sterilizers
Fans	Insect traps and sprayers	Tank heaters
Feed Grinders	Milk coolers	Water heaters
Feed Mixers	Milk mixers	Water systems



Electric poultry water warmers encourage drinking; boost egg production; keep water from freezing. Note time switch for hen house lighting.

Electric winch on wood skids hoists hay into barn; relieves tractor for field work. Effective manpower is multiplied by utilizing this equipment.



Portable motors are valuable assets, applicable for cutting wood, mixing concrete, filling silos and numerous additional chores.

the vacuum pipe as an added safety measure plus proper motor grounding.

All ironclad farm buildings should have the metal sheeting bonded together and grounded for lightning protection (Minnesota Farmstead Wiring Regulations). Metallic raceway systems as well as the neutral ground wire within such units must be bonded to the lightning ground system.

Automatic Control

A fair amount of automatic electrical control is now used on the farm. Lighting for poultry houses particularly use one or more time switches depending upon the type of lighting and "time schedules" required for older chickens and pullets. (Fig. 9, A, B, C, D). Barn, poultry house and other building ventilation and electric heating is thermostatically controlled. As electro-agriculture progresses, more applications will be found for automatic controls. The present market includes such items as: Water-level control on pump-fed gravity tanks; stock tank heaters; yard lighting and poultry house exterior floodlighting (protection against chicken thieves). With the trend toward more motors of smaller size for various farm applications, pushbutton and automatic control may become standard practice on the modern farm of the future.

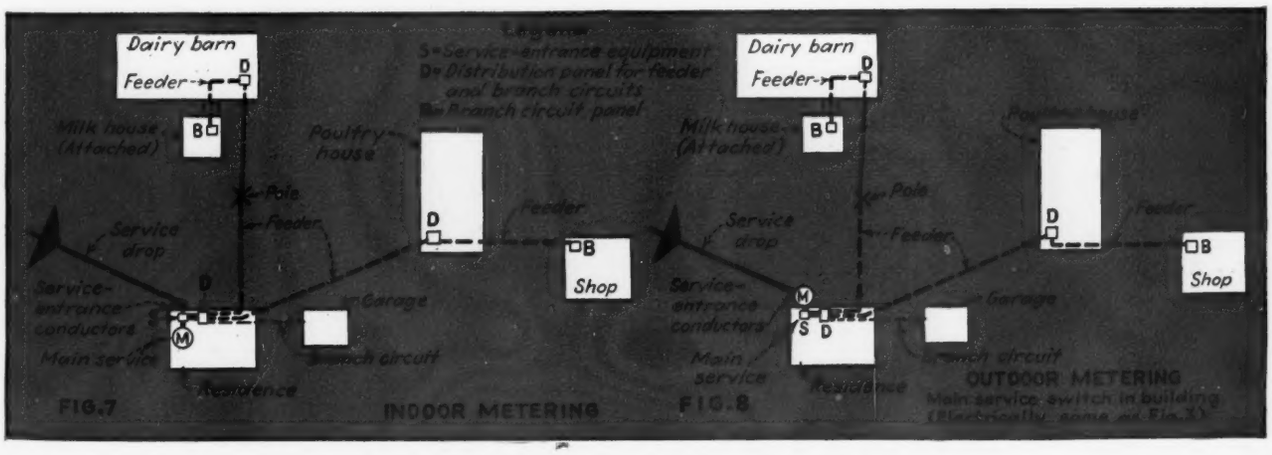
Separate Circuits

Good engineering practice dictates the installation of separate circuits to equipment and areas where life processes, produce refrigeration and safety depends on electric service. Included in this category are poultry house equipment, milk and produce coolers, water pumping stations, yard lights and protective lighting. This is in addition to separate circuits needed for home appliances as outlined in the various Codes.

The increased use of electric welders on farms has presented somewhat of an electrical headache in the past. As a result of a thorough study by the Rural Electric Equipment Council, North Central Electrical Industries, the following recommendations were made:

Resistance type welders are not recommended for farm or general purpose use. The motor-generator type will find only limited application in large farm repair shops because of higher initial cost.

Transformer type arc welders of approved construction are permitted.



FARM WIRING...

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TABLE VII. Service Equipment—Farm Structures

Type of Building		Installation	Electrical Service: Type	Service Capacity (Amperes): Entrance Conductors	Switch	Fuse	Circuit Breaker
Dairy Barn (Complete Barn including Milk Room)	Small (Up to 1000 sq. ft.)	Normal amount of lighting. Water pump. Utility motor (up to 5 hp.)	3 wire, 115/230 V.	50	60	60	70
	Medium (Up to 2500 sq. ft.)	Normal amount of lighting. Milking machine, milk cooler. Water heater. Utility motor (up to 5 hp.)	3 wire, 115/230 V.	65	100	80	90
	Large (Above 2500 sq. ft.)	Normal amount of lighting Milking machine, milk cooler. Water heater, water pump. Utility motor (up to 7½ hp.)	3 wire, 115/230 V.	95	200	150	125
Milking Barn (Including Milk Room—Cows not Housed)		Normal amount of lighting. Milking machine, milk cooler, water pump, water heater and sterilizer.	3 wire, 115/230 V.	35	60	35	35
Milk House (When Seperate from Barn)		Normal amount of lighting. Milk cooler, water heater and sterilizer.	3 wire, 115/230 V.	30	30	30	35
Horse, Beef Cattle, Sheep and Hog Barns	(Small (Up to 1000 sq. ft.)	Normal amount of lighting. Pig or lamb brooders. Utility motor (up to 1 hp.)	3 wire, 115/230 V.	30	30	30	35
	Medium (Up 2500 sq. ft.)	Normal amount of lighting. Pig or lamb brooders. Utility motor (2 to 5 hp.)	3 wire, 115/230 V.	50	60	60	70
	Large (Above 2500 sq. ft.)	Normal amount of lighting. Pig or lamb brooders. Utility motor (up to 7½ hp.)	3 wire, 115/230 V.	70	100	100	100
Poultry Laying House (Including Feed Room)	Up to 4000 sq. ft. pen floor area	Normal amount of lighting. Water warmer. Feed grinder (up to 1 hp.)	3 wire, 115/230 V.	30	30	30	35
	Above 4000 sq. ft. pen floor area	Normal amount of lighting. Water warmer. Feed grinder (up to 2 hp.)	3 wire, 115/230 V.	50	60	50	50
Poultry Brooder House	Single Brooder (Portable)	Normal amount of lighting. Brooder-water warmer.	2 wire, 115 V.	20	30	15	15
	Colony Brooder House (Up to four)	Normal amount of lighting. Brooders-water warmers.	3 wire, 115/230 V.	30	30	30	35
	Colony Brooder House (Above four)	Normal amount of lighting. Brooders-water warmers.	3 wire, 115/230 V.	(Estimate 1250 watts per brooder pen)			
Poultry Cleaning and Dressing		Normal amount of lighting. Poultry scalder, waxer, wax reclaimer, picker, and refrigerator equipment.	3 wire, 115/230 V.	50	60	50	50
General Farm Buildings		Minimum capacity where lighting, motors, and miscellaneous 115 and 230 volt equipment will be used.	3 wire, 115/230 V.	30	30	30	35
		Minimum capacity where only lighting and small portable tools may be used.	2 wire, 115 V.	30	30	30	35

From: Handbook of Farmstead Wiring Design.

Manufacturers should clearly state limitations of units and emphasize necessary safety measures.

Rating and Size—Welders having an *input* rating of 12 amperes or less at 110-volts can be connected to a 110-volt circuit. Those with a primary input rating of more than 12 amperes should be ***equipped with a special 3-pole polarized plug for connection to a 220-volt, 3-wire circuit.*** For ordinary farm repair purposes a 150-ampere welder (rating) should be acceptable both as to performance and use on farms served by a 3 kva. or larger transformer. In all cases the local utility should be consulted on welder installations—especially if the unit is to be rated at 200-amperes or larger. Recommended conductor sizes to feed welders of different ratings are listed in Table VIII. Although not required by all REA projects and power companies, power factor correction is desirable. It may permit the use of a welder on the present transformer serving the farmstead.

Control Equipment — Switches or circuit breakers for control of transformer type arc welders should be of the motor-circuit type having a full load current rating corresponding to the rated full load of the welder. For power factor corrected units (to at least 75 percent), general use switches having a rating not less than twice the full load rating of the welder may be used. (Minnesota Farmstead Wiring Regulations, 1946 Edition).

Wiring Methods

In all there are several types of wiring that may be used on the farmstead: non-metallic sheathed cable; armored cable; open wiring on insulators; knob and tube wiring; conduit (rigid and electrical metallic tubing); and surface metal raceways. Generally speaking, no one method can be used throughout the entire farmstead.

The following rules, based on REA and local code regulations, find general application to farmstead wiring:

Conduit—either rigid, thin-wall or flexible *is not approved* for installation in stock barns, dairies, well houses and other buildings likely to contain corrosive atmosphere. Where necessary for mechanical protection or fire safety in other locations (haymows, areas with combustible dust, etc.) conduit must be galvanized, sheradized, cadmium plated or sprayed aluminum finish.

Armored Cable—Is not approved for

TABLE VIII. Recommended Electrical Outlet Locations

FARM PRODUCTION AREA	OUTLET LOCATION		
	Lighting	Convenience	Special Purpose
DAIRY STRUCTURES			
Dairy Barn	Every 12-ft. in litter alley; 20-ft. in feed alley. Separate wall switch control.	Every 20-ft. in litter alley. At certain windows and doors for insect screens; at vent fan (less than ½ hp.)	At vent fan (½ hp. or over). At pipe-line milker (230-v). At ultra-violet lamp (one 30-in. unit for 30-100 sq. ft. floor area). –
Loafing Barn –	One for every 250 sq. ft. of open pen—in feed alley every 20 feet. Separate wall switch control.	At convenient-places-	
Box Stalls or Pens	One per stall Low partitioned stalls—one outlet per two stalls. Wall switch control	One per stall	At ultraviolet lamps (one 30″ unit for 80-100 sq. ft.)
Milking Barn or Room	On center line of passages. Front of cows — one per 6 cows. Back of cows —one per 3 cows. Separate wall switch control.	One per every 4 or 5 cows. At vent fan (less than ½ hp.)	At milking machine. At vent fan (½ hp. or over). At ultraviolet lamp (one 30″ unit for 60 sq. ft.)
Milkhouse or Milkroom	One for every 150 sq. ft. One at loading platform. Wall switch control.	One for each work area (No. 12 wire minimum). At vent fan (less than ½ hp.)	230-volt At vent fan (½ hp. or over At milk cooler At water heater At utensil sterilizer
POULTRY STRUCTURES			
Laying House —Morning Lighting	One for every 200 sq. ft. 20-ft. deep house—single row on 10-ft. centers, midway between front of house and dropping board (40 watt lamps). Over 20-ft. depth with roosts at back of pen—two rows of outlets on 10-ft. centers staggered; with roosts in center of pen—two rows of outlets on 10-ft. centers, one midway between dropping board and front of house, other between board and rear.	One for every 400 sq. ft. At least one per pen on post or walls 3 ft. above floor. No. 12 wire minimum.	One at vent fan. At ultraviolet lamps (one 30″ unit for 100 sq. ft.
—Morning and Evening Lighting	Bright lights—same as above. Dim lights —on separate circuit, one outlet for every 400 sq. ft. in a row slightly back of bright lights toward roosts (10-15 watt lamps).	Control for lighting at left. Time switch control on all but all-night lighting. Lights should have 4-in. deep, 16-in. dia. reflector with aluminum or aluminum bronze reflecting surface.	
—All-Night Lighting	Same as for morning lighting (15 to 25 lamps).		
Brooder House —Portable Type	One on ceiling or wall near door	One in center of space for brooder water warmer	One for ultraviolet lamp (one 30″ unit for every 100 sq. ft.)
—Colony Type	One per brooder pen individual or group control by wall switch.	One per pen on ceiling over brooder —brooder and water warmer — 1150 watts).	One for ultraviolet lamp as above.
Egg Storage and and Handling Room	One for every 200 sq. ft.; two over each working surface — wall switch control.	One for egg cooler or humidi.er fan; at egg candler, egg cleaner and egg grader.	At refrigeration unit (½ hp. or over).
Poultry Dressing Room	Same as for egg storage and handling.	One for every 400 sq. ft.	230 volt outlets At poultry scaler — 1000 to 4500 watts At waxer — 1000 watts At wax reclaimer — 1500 watts At picking machine ¾ to1 ½ hp. At refrigerator — ½ ho. and up.

FARM PRODUCTION AREA	OUTLET LOCATION		
	Lighting	Convenience	Special Purpose
ANIMAL STRUCTURES			
Beef Cattle Barn	One for every 250 sq. ft. of open pen area; those in feed alley on 20-ft. center, others to facilitate chores. Feed alley outlets separately controlled.	At convenient locations for equipment use.	At vent fan ½ hp. or over — 230 volts. Less than ½ hp.— 115 volts.
Horse Stables —Tie Stalls	Litter Alley — one back of each pair of tie stalls in center of alley. Feed Alley — one every 20 ft. in center of alley. Box Stall — one per stall; with low separating p .rtitions — one for each two adjacent stalls, over partition. Each group of outlets to have separate wall switch control.	Litter Alley — one at every third tie stall. With center litter alley — one outlet will serve six stalls, three on each side. One near entrance of box stall.	At ultraviolet lamp (one 30″ unit for 80-100 sq. ft.)
—Individual Stalls	Every 20 feet in center of feed alley; one for each pair of stalls over partition (one per stall if partition is too high). Separate wall switch control for each group of outlets.	One for each four stalls — in feed alley.	At ultraviolet lamp (one 30″ unit for 80 sq. ft.)
Hog and Farrowing House	One for each pair of pens over partition — with wall switch control.	At each farrowing pen for pig brooder and water warmer. Where possible — one outlet can serve two pens.	
FARM CROPS			
Feed Processing Room	One for every 200 sq. ft.— wall switch control.	At fan, heater, small corn sheller, fanning mill, etc.	½ hp. and over — 230 volts At feed grinder At feed mixer At corn sheller At grain elevator
Feed Storage Room	One for every 400 sq. ft.— wall switch controlled.		
Barn Floor Area	Note: May be "drive-in" area at end of stable, or above stable in barns where livestock are housed on first floor and hay, straw or machinery stored on second floor.		
	One for every 400 sq. ft.	One for every 1000 sq. ft.	230 volts At hay hoist—2 hp. and larger At hay dryer—3 to 7½ hp. At portable elevator —1 hp.
Haymow or Hayloft	At least one for each haymow — wall switch control at convenient location.		230-volt At hay hoist—2 hp. or larger At hay dryer—3 to 7½ hp.
	Note: Lighting outlet may be located near roof peak (6 ft. clearance for hay track); or a floodlight high at one end of haymow; or outlets may be at diagonally opposite corners of area. Good location is purlin or hip of roof, one third of way down from ridge or peak. Units should light hay chutes and ladders and be readily accessible for cleaning when mow is empty.		
Silo	One on ceiling of silo and at top and bottom of chute — wall switch control at foot of chute		230-volt At ensilage cutter, blower—5 to 7½ hp. At silo unloader— 1 hp. and larger
Fruit and Vegetable Storage	Every 20 feet in alley — wall switch control	One for every 400 sq. ft. of floor area	½ hp. and over — 230 volts At refrigeration equipment At vent fans
Sorting, Grading, Washing and Packing	One for every 200 sq. ft. of open area— wall switch control.	One for every 400 sq. ft. of open area	½ hp. and over — 230 volts At washing equipment At sorting equipment At grading equipment At conveyor

FARM WIRING...

An Expanding Market

installation in basements of dwellings, stock barns, dairies, well houses, nor in other buildings likely to contain damp or corrosive atmosphere, or where exposed to weather.

Metal Raceways—Approved only for dry locations not subject to mechanical injury. Maximum wire size, No. 8; maximum fusing, 30 amperes.

Nonmetallic Sheathed Cable—Approved for use where conduit or armored cable is not permitted, but cannot be installed in masonry or concrete.

Knob and Tube Wiring—Same general rule as for nonmetallic sheathed cable.

Outlets, Boxes, Switch and Receptacle Plates—In outbuildings should be of nonmetallic type to conform to the wiring installed. Switch and receptacle plates in bathrooms, kitchens and basements of residences must be nonmetallic (REA specifications).

Outdoor Outlets for portable equipment must be of approved weatherproof type.

The foregoing portrays farmstead wiring as it should be installed to provide safe, economical, flexible, reliable service. It is not the simple "house wiring" job that many consider it. Each installation involves a number of wiring methods tailored to actual occupancy and use conditions. As such it demands thoughtful engineering and planning on the basis of individual requirements. The answer to the past attitude that "anyone" can make the installation or that a farm can be adequately wired on a simple "cost-per-outlet" basis is clearly evident.

Responsibility for complete and adequately wired farms is squarely on the electrical contractor who can give the farmer what he thinks he wants, or sell the type of installation the farmer really needs to do a productive job. Power companies are bringing the kilowatt to the farm property; electrical contractors can take it to the outbuildings where it is needed most. That is their job.

TABLE IX. Farm Building Loads and Probable Demands

Building	Estimated Load*	Probable Demands**
Farm Residence	7–12 kw.	7 kw.
Dairy Barn	8–16 kw.	0.5 watt per sq. ft. barn area plus 5 kw. for small and medium barns and plus 7.5 kw. for large barns.
Milkhouse	2–6 kw.	10 watts per sq. ft. floor area.
Poultry House	8–16 kw.	
Single pen		1.5 kw.
Each additional laying pen		0.4 kw.
Each additional brooder pen		1.25 kw.
Poultry cleaning, dressing, waxer, etc.	5 kw.	
Farm Work Shop and Machine Shed Including Welder	6.5 kw.	5watts per sq. ft. area of shop.
Granary, Hog House, Corncrib, sheep shed	5–11 kw.	
Stock Shelters and Miscellaneous Buildings		1 watt per sq. ft. floor area
Sweet Potato Curing and Storage House		4.5 watts per bushel storage capacity (2.5 bu. per sq. ft. of house area)
Pump House	Demand depends on depth of well.	

* General Electric Company.
** Handbook of Farmstead Wiring Design.

TABLE X. Service For Farm Residence

The size of service-entrance conductors and the rating of service equipment shall not be less than that specified for the floor areas in the table below. All service shall be 3-wire, 115/230 volt.

Floor Base (Sq. Ft.)	Capacity Service Conduct. (Amperes)	Rating of Service Equipment			The service capacities provided for in table are sufficient to supply lighting, portable appliances, a range, a water heater, and additional appliances, supplied, by individual equipment, circuits having a total rating in watts as follows:
		Circuit Breakers	Switch and Fuse		
			Switch	Fuse	
Up to 1000	60	70	60	60	3500
To 1500	65	70	100	70	4200
To 3000	85	90	100	90	8800
To 4000	100	100	100	100	9500

The above table provides service sizes adequate for normal lighting and portable appliance loads and for a range and a water heater. In addition it provides for a possible increase by the amounts shown in the last column. If these wattages are to be exceeded, service size should be increased accordingly. If, however, the initial wattages are less than those shown, the service sizes should be at least those given above, so that future growth in load may be accommodated.

From: Handbook of Farmstead Wiring Design.

TABLE XI. Special Circuits

Appliance*	Wire Size
Range	3 No. 6 Awg.
Water Heater	2 No. 12 Awg.
Dishwasher-Disposal	2 No. 12 Awg.
Room Cooler	2 No. 10 Awg.
Room Heater	2 No. 10 Awg.
Oilburner	2 No. 12 Awg.
Laundry Drier	3 No. 12 Awg.
Attic Fan	2 No. 12 Awg.
Quick Freezer	2 No. 12 Awg.

Farm Electric Welders**

In general, conductor sizes for circuits supplying transformer arc welders should be as follows:

Rating of Welder	Wire Size
100–125 Amp.	No. 10
150–160 Amp.	No. 8
200–260 Amp.	No. 6

Note: Welders with a primary input in excess of 12 amperes at 110 volts should be equipped with a special 3-pole polarized plug for connection to a 220-volt, 3 wire circuit.

Sources: * General Electric Company.
** N. C. E. I. Rural Electric Equipment. Council Recommendations.

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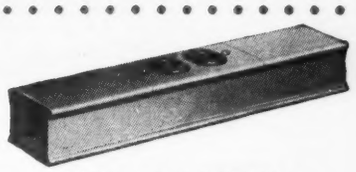

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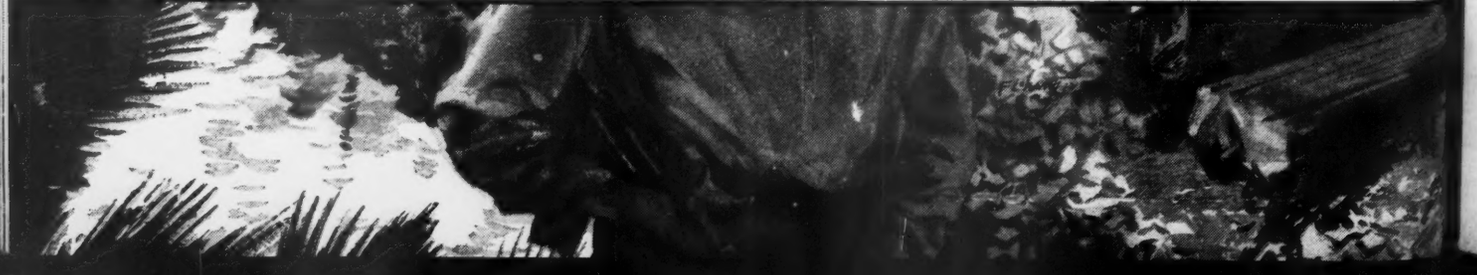

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Had it not been for his confidence there would have been no Brooklyn, George Washington nor Golden Gate Bridges. Had it not been for your confidence in the company that bears this pioneer's name, there could have been no John A. Roebling's Sons Company.

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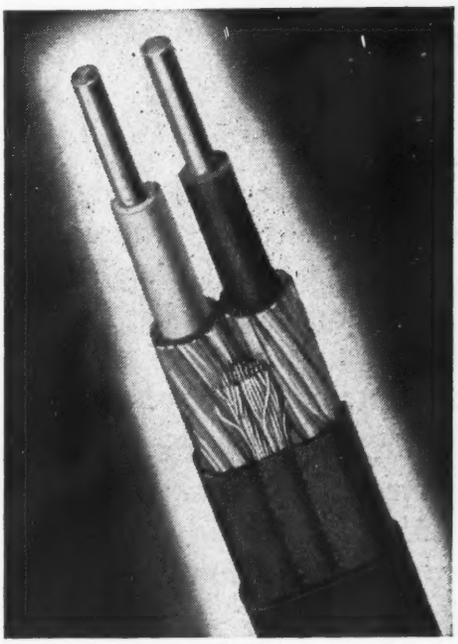
An important factor in any product's performance is its suitability to the specific service conditions. The Roebling Field Engineer can help you choose the *right* wire or cable . . . assure you of getting *all* the service it's made to give. Call or write our nearest branch office . . . he'll gladly consult with you.



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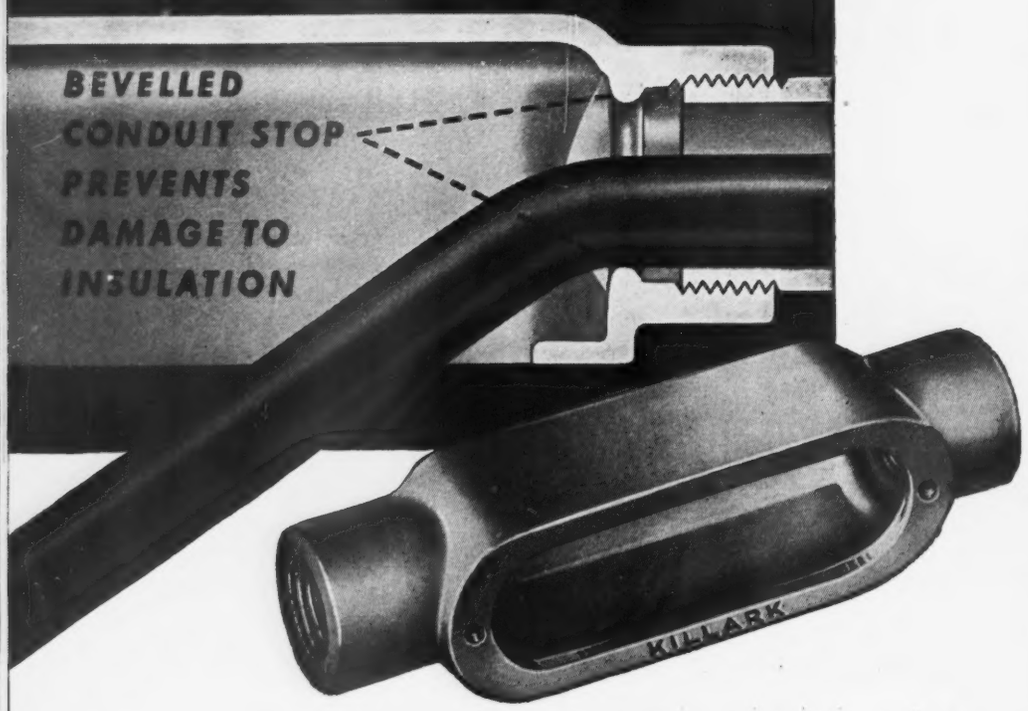

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Practical Methods

Test Board Speeds Fluorescent Service

TESTING

Through the ingenuity of shop superintendent J. A. Lund, the time required to service fluorescent fixtures at Wigdahl Electric Company, Chicago, has been reduced to a minimum. By means of a test board he designed and built, he can quickly diagnose the trouble on practically every type of equipment that comes into the shop.

Compact in design, yet simple in operation, the board (Fig. 1) has facilities for checking 15-, 20-, 30- and 40-watt fluorescent lamps, starters, single lamp and two-lamp ballasts; also standard fuses, incandescent lamps, appliances and portable electric tools.

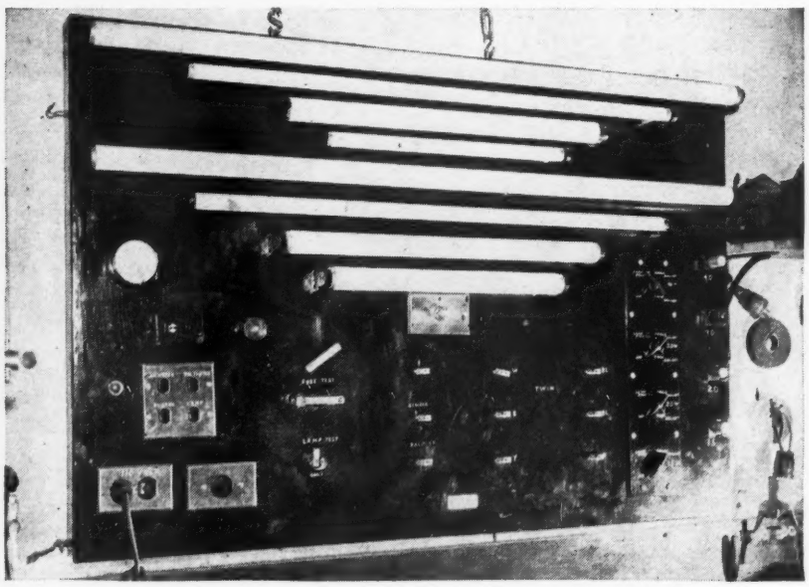

Fig. 1—Fluorescent lamp, accessory and appliance test board designed and built by Wigdahl Electric Co., Chicago, for use in its repair shop.

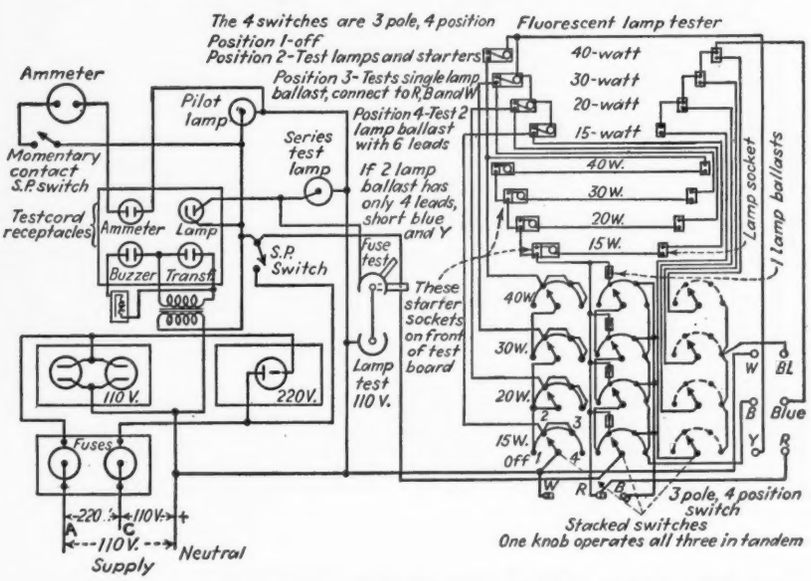

FIG. 2—Diagram of circuit connections on back of the test board.

Two groups of lamps are mounted on the board. The top group (See Figs. 1 and 2) for lamp testing, has combination starter sockets; the lower group for starter testing, is connected to individual starter sockets mounted on the face of the board. Spring clip terminals at the center of the board are for testing single and two-lamp ballasts.

To assure practically fool-proof operation, Lund uses only four switches on the fluorescent test side—one for each of the four lamp sizes on the board. These units are of the 3-pole, 4-position tandem type (Fig. 2). Switch positions are: (1) off; (2) lamp or starter test; (3) single lamp ballast test; and (4) two-lamp ballast test. The operator merely connects the item on test, selects the proper switch (wattage) and turns it to the designated position.

The lower left corner of the board contains a four gang receptacle for ammeter, voltmeter, buzzer and series lamp (continuity) tests; also 110- and 220-volt single phase outlets for general test purposes.

Waterproofing Open Type Motors

INDUSTRIAL

From M. D. Pollock of Valley Stream, Long Island, N. Y., comes a field-tested idea for making open type motors watertight through the use of an internal pressure system. The necessity for adapting an open induction motor to watertight service was due to the difficulty in securing totally enclosed units.

An open type induction stator was fitted with two ball bearing type splash proof end bells which happened to be available. A piece of 16 gauge sheet steel was formed around and bolted to the open center section of the stator and sealed with No. 1 Permatex. The conduit box was stuffed with paper to form a crude mold and then filled

"Exhibit A"

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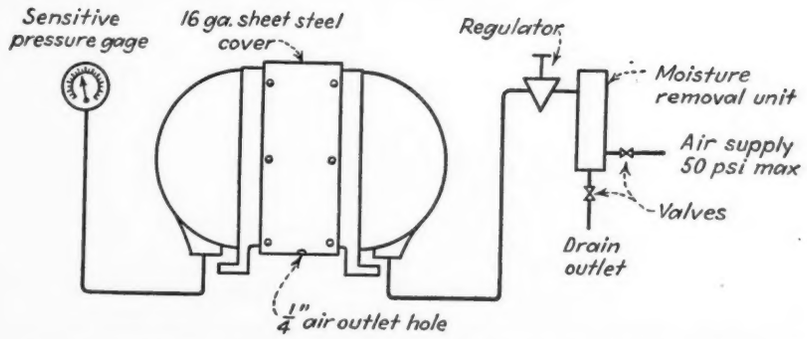

Open type motor is changed to a splash-proof unit by installing a sheet steel cover around the center section of the stator and available splash-proof end bells at either end. The sealed motor is fitted with nipples connecting motor, by copper tubing, with pressure indicator and moisture-free air supply. Weep-hole in bottom of sheet steel cover permits air outlet. Positive low-level pressure prevents motor from breathing in water and motor is capable of operating in locations requiring waterproof equipment.

with molten pothead compound. This effectively sealed off the stator except for a quarter inch hole drilled into the sheet metal at the bottom of the motor to permit an air outlet.

The bottom opening of the splash proof end bells were sealed with 16 gauge sheet steel with ¼-inch pipe nipples brazed into the center. One nipple was piped with copper tubing to a source of moisture free air. An air pressure regulator ahead of the moisture removal filter was adjusted to operate between 3 and 8 ounces per square inch, the pressure being registered by a sensitive pressure gauge which was piped with copper tubing from the other nipple.

The ¼-inch hole at the bottom of the motor permitted sufficient cooling air to enter and leave the motor to make up for the extra heat due to lack of ventilation. If the motor overheats, extra holes may be drilled and the pressure may be regulated accordingly. The small positive internal air pressure, applied continuously, prevents the motor from breathing in water. The success of the principle is proven by the fact that motors such as these are in actual use under conditions where water continually flows over them.

Ring Support for Area Floodlighting

WIRING

Clusters of pole-mounted floodlights will illuminate parking areas at the new Chevrolet Flint plant of the General Motors Corporation. To assure an even distribution throughout the area, units are mounted on the periphery of a ring platform near the pole top (Fig. 1).

These supporting rings, chosen by Albert Kahn Associated Architects and Engineers, Inc., Detroit, project architects, and installed by the John Miller Electric Company, Detroit electrical contractors, are furnished as standard equipment by the Union Metal Manufacturing Company as accessories to their line of metal poles.

Rings are made of 3½-in by 3¼-in. angle iron, are 4-ft., 6¾-in. in diameter, rest on three conduit "spokes" fastened to the pole, and are securely mounted by U-bolt assemblies. Each ring accommodates eight, 1500-watt, narrow beam outdoor floodlights. Number of rings per pole varies from one to three, depending upon the concentration of reflectors needed. The highest ring is installed four inches from the top of the 60-ft. pole; others are mounted at three-foot intervals underneath. Conduit supporting "spokes" also enclose the No. 8 branch circuit conductors feeding the individual floodlights.

Mounted eight feet below the top ring (two feet below space reserved for future ring) is an eight-circuit, weatherproof lighting panel fastened to two 2½ in. couplings welded into the post. Depending upon requirements, panels have either eight 35-amp. single-pole breakers, or four breakers with space for four spares.

Serving the floodlights is a 25 kva., 3-phase, 480-120/208 volt, oil filled transformer suspended from an angle iron support immediately below the lighting panel. Primary (3-No. 4) and secondary (4-No. 1/0) conductors encased in the pole emerge through suitable service heads for connection to the transformer terminals. Covered handholes (2 in by 4 in.) cut into the pole opposite the service heads and lighting panel and at the base (4 in. by 6 in.) facilitate conductor installation. A weatherproof junction box (15 in. by 15 in. by 6 in.) in the concrete base provides access for connection to the underground distribution cables, also space for a 600-volt, 60 amp. 3-pole fuse cut-out.

Height of the poles is ample to permit the floodlighting units to be individually adjusted for maximum effectiveness and uniformity in lighting the parking areas.

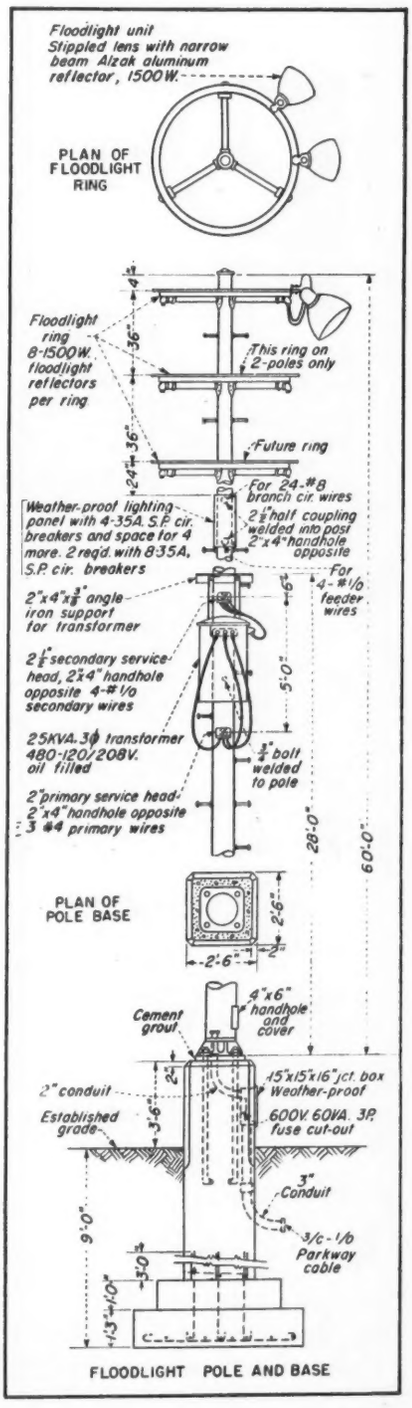
Floodlight unit Stippled lens with narrow beam Alzak aluminum reflector, 1500W.
PLAN OF FLOODLIGHT RING
Floodlight ring 8-1500W. floodlight reflectors per ring
This ring on 2-poles only
Future ring
For 24-#8 branch cir. wires
2½" half coupling welded into post 2"x4" handhole opposite
Weather-proof lighting panel with 4-35A. S.P. cir. breakers and space for 4 more. 2 req'd. with 8-35A. S.P. cir. breakers
For 4-#1/0 feeder wires
2"x4"x¼" angle iron support for transformer
2½" secondary service head, 2"x4" handhole opposite 4-#1/0 secondary wires
25KVA. 3ϕ transformer 480-120/208V. oil filled
¾" bolt welded to pole
2" primary service head 2"x4" handhole opposite 3 #4 primary wires
PLAN OF POLE BASE
Cement grout
4"x6" handhole and cover
2" conduit
Established grade
15"x15"x16" jct. box Weather-proof
600V 60A. 3P. fuse cut-out
3" Conduit
3/c-1/0 Parkway cable
FLOODLIGHT POLE AND BASE

FIG. 1—Details of parking area floodlight installation showing ring support of floodlight clusters to assure even lighting distribution. Note transformer and panel installation on each pole.

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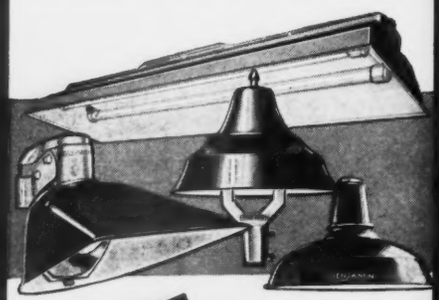

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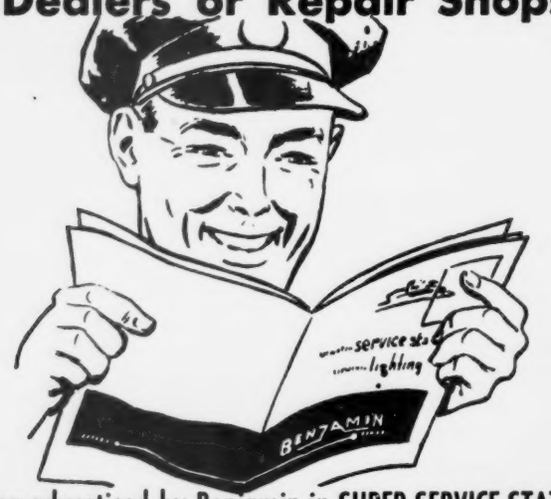

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2216

Dry Type and Askarel Insulated Transformers—Part II

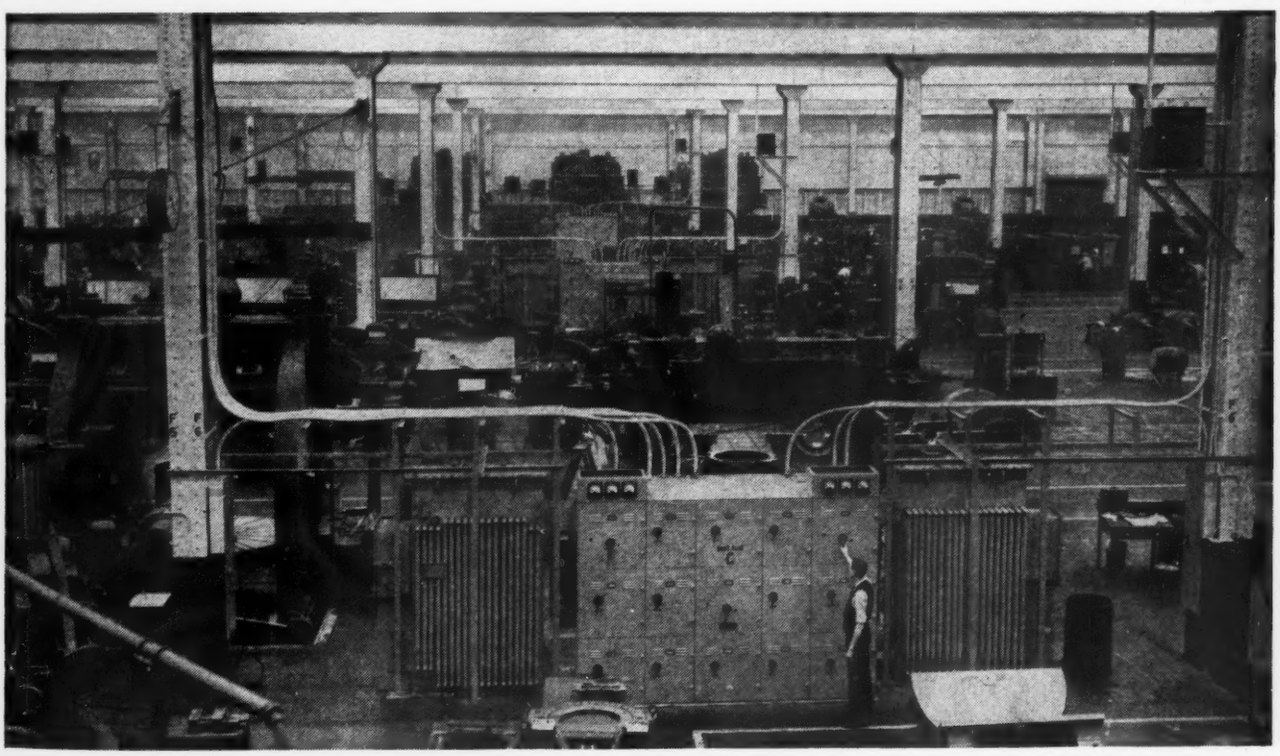
Second of a series of two articles on why, when and where to apply dry and askarel insulated transformers in industrial plants and commercial buildings.

By M. L. Hurni
Distribution Transformer Section
General Electric Company

Comparison of Operation Under Normal Conditions

If the correct size transformer is selected and proper attention has been given to the factors outlined above, it is to be expected that either type of transformer would perform successfully. The one difference to be expected is in the method of maintenance. Either transformer must receive proper maintenance if successful operation is expected. The type of maintenance required will be quite different because of the presence of liquid in one and the exposure of the coils in the other.

In the askarel insulated transformer it is necessary to maintain the liquid in good condition. Since askarel is an unusually stable liquid and is contained in a tank that can be maintained sealed, it should be expected that the insulating strength of the material will maintain itself over long periods of time. It is usually sufficient to check the dielectric strength in the order of once a year or less frequently. However, in such transformers it is essential that leaks through which askarel



Load-center unit-substation installation, employing askarel transformers in a large machine shop. Notice the three substations visible in the area, each supplying power to a small section of the factory for lights and machine tools.

can escape or moisture can enter be avoided. This requires that gaskets, valves and fittings be maintained in a tight condition. In the event the insulating quality of askarel is reduced by the entrance of moisture or other contaminating matter, filtering of the liquid will be required.

For filtering, best results are obtained with a filter press combining the use of blotter paper and Fuller's Earth. Presses used for conventional insulating oil can be used. However, it is essential, if a press used for filtering insulating oil is employed, that it be cleaned thoroughly before use with askarel as it will be desired, naturally, to keep such inflammable transformer oil as may remain in the press from contaminating the non-inflammable askarel.

It is essential that the coils and insulating surfaces of the dry type transformer be kept reasonably clean and free of dirt so that insulation strength is maintained and also to permit the dissipation of heat at the rate and in the manner intended by the designer. The amount of maintenance is dependent, therefore, upon the atmosphere in which the transformer is operated. Under conditions such as are encountered in certain modern factories and in office buildings, it is quite likely that occasional blowing out with dry air is all that will be required. To do this cleaning the transformer should be deenergized. If oil vapor, for example, is present along with dirt the problem of maintenance may be quite difficult.

Comparison of Operation Under Abnormal Conditions

Operation under abnormal conditions falls into two parts:

1. Operation while carrying overloads.
2. Failure of the transformer.

Carrying Overloads

Loading curves recommended by the American Standards Association for liquid filled transformers are applicable to askarel insulated transformers. The average temperature of the windings and the liquid temperature will rise above the guaranteed values by amounts depending upon the factors of safety employed and skill in designing. The performance is quite similar to that of oil filled transformers under similar circumstances with the exception that askarel being a stable liquid will not deteriorate under severe conditions as does oil.

Although there are no industry standards yet arrived at for the overloading of dry type transformers it is to be expected that the manufacturers would adhere as closely as possible to the loading performance for liquid filled transformers in order to be competitive. In broad terms the performance of the dry type unit under conditions of overload is quite similar to the askarel insulated type.

Consequences of Failure

A great deal of attention is quite frequently given to the consequences of failure with little attention being paid to the characteristics of the transformers that may make failure an unlikely probability. If one considers the characteristics that may under circumstances make the incidence of failure more likely and selects transformers accordingly and if one employs the proper protective devices, the probabilities of the failure are small and the possibilities of the consequence to be discussed below remote.

The effects to be observed in the case of failure are dependent upon the energy available at the fault. When transformers do fail, the failure usually begins as a partial winding failure with considerable impedance in the circuit between the fault and the source of power. This limits the energy available at the fault and consequently if proper short circuit protective devices are employed with the transformer to open the circuit quickly, the more severe phenomena to be discussed below will quite likely be observed.

The Class B insulated dry type transformer is insulated with inorganic insulations and impregnated with an organic binder. In the case of failure the organic binding material will be subject to deterioration if the energy available at the fault is sufficient or if the failure is allowed to persist. This deterioration will result in the liberation of hydrocarbon gases and smoke. With very high energy release, the binder and the gases liberated will ignite. It is this contingency that results in the code recommendation that there should be a six foot horizontal and a twelve foot vertical separation between such a transformer and combustible material. After the transformer has ignited it will continue to burn until the binding material present is used up regardless of whether power is removed or not. However, after the transformer is deenergized the fire can be controlled by the usual fire extinguishing means.

Installation of 150-kva. askarel transformers in the basement of an office building. These transformers supply power and lighting and for the building's service devices located principally in the basement.

The phenomena here described are the extreme cases and the probabilities of their occurring are not great, particularly if the transformer is protected against overload in accordance with modern practices.

In the askarel insulated transformer the effect of failure is quite different. The temperature resulting from an electric arc in the transformer may cause the askarel to break down. The principal products of this disintegration are a non-inflammable and non-explosive gas, itself having fire extinguishing properties, and flocculent carbon. The gas, known as hydrogen chloride is stable, has a pungent, irritating odor and in sufficient concentrations is suffocating.

The rate at which this gas is generated depends upon the energy available and the duration of the fault. As was pointed out above, most transformer failures occur as partial winding failures and hence the amount of energy in the fault is of a relatively low value and the amount of gases generated may consequently be small.

In time, the generation of gas may build up sufficient pressure within the sealed tank to rupture the relief diaphragm with which such transformers are equipped. Under conditions where no gas absorber is employed or no piping to the outside atmosphere is installed, the gases will be exhausted into the area around the transformer. This accounts for the code requirements relative to poorly ventilated areas.

As was pointed out before, the gas gives evidence of its presence by its sharp odor. It is highly soluble in water and can be dissipated by water spray. However, the resultant run off water will be acidic. An ordinary gas mask is also effective against it. It should also be noticed that the gas is generated only during the period re-

quired to clear the failure as contrasted with the dry type transformer where burning once begun will continue until the burning varnish has been extinguished or burns itself out.

With a sealed tank, it is further possible, theoretically at least, to generate gas at a sufficiently high rate in the presence of very large amounts of energy to rupture the transformer tank, releasing hot liquid askarel through the tank break.

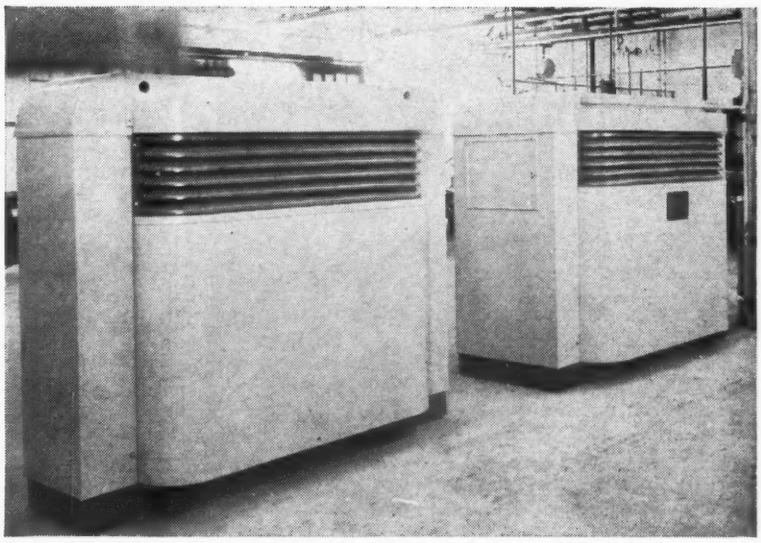
Attention must again be called to the fact that transformer failures usually begin as low-energy partial winding failures. Transformers incorporated in a modern industrial distribution system will usually be removed by the short circuit protective devices before serious trouble develops. Furthermore, this type of trouble is more apt to occur on the largest metropolitan secondary network systems. In these cases the available capacity is high, of the order of a half million kva., and the sensitivity of the short circuit protections relatively low, as many as 50 500 kva. transformers may be connected to a feeder with only the main feeder breaker for protection. While the energy may be as high in an industrial plant, the type of protection usually found under average conditions is far different, as indicated by Par. 45126 of the National Electrical Code.

Overcurrent Protection—Primary and Secondary Side

A transformer having an overcurrent device in the secondary connection, rated or set at not more than 250 percent of the rated secondary current of the transformer, or a transformer equipped with a coordinated thermal overload protection by the manufacturer, is not required to have an individual overcurrent device in the primary connection provided the primary feeder overcurrent device is rated or set to open at a current value not more than six times the rated current of the transformers for transformers having not more than six percent impedance, and not more than four times rated current of the transformer for transformers having more than six but not more than ten percent impedance.

On a properly protected installation, it is probably safe to say that tank rupture of the askarel insulated transformer and ignition of the Class B Insulated dry type transformer are equally remote.

Although it is the intent of this article to compare modern transformers, it is desirable to mention another circumstance that arises in the case of failure of older askarel insulated transformers.



Two 150-kva Class-B-insulated dry type transformers located on the factory floor in a small glass factory. They supply power to a small furnace and for lighting and miscellaneous loads. The area is clean and dry and primary voltage comes from an extensive underground system.

CHECK CHART

Problem	Conditions	Type Recommended Dry Type	Type Recommended Askarel Insulated
Exposure to Lightning	1. Where transformers are connected directly to circuits exposed to lightning and only the usual protection is provided.	No	Yes
	2. Where study has determined that the amount of lightning exposure is negligible, for example: a. Areas of extremely low lightning incidence. b. Underground cable supply. c. Overhead supply with usual protection, feeding into long primary cable runs for at least 1500 feet.	Yes	Yes
Atmospheric Conditions or Location	1. Where atmospheric conditions are relatively clean, for example: a. Plants producing aircraft instruments and precision parts, assembly plants, food processing plants, office buildings, hospitals, etc.	Yes	Yes
	2. Where dirt conditions are severe, such as in foundries, steel mills, flour mills, cement mills, etc.	No	Yes
	3. Where moisture conditions are severe, such as in geographical locations of high humidity or where transformers may be subjected to partial or total submersion.	No	Yes
	4. Where units are subjected to acid, oil or corrosive vapors.	No	Yes
	5. Where units are located in areas classified as semi-hazardous (See Article 500 of National Electrical Code for guidance).	No	Yes
	6. Underground in mines, tunnels and subways where units are subject to dirty and moist atmosphere.	No	Yes
	7. All other conditions being satisfactory and the transformers are to be located overhead on platforms or roof trusses.	Yes	No
	8. Installations in tropical climates where severe conditions of fungus growth are prevalent.	No	Yes
Flexibility For Future Applications	Where possible rearrangement may cause the transformer to be moved out of doors at a later date.	No	Yes

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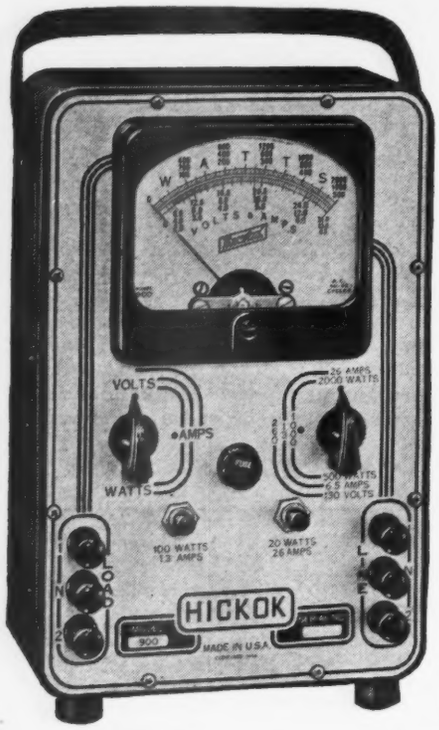

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Some moisture is always in solution in liquids and askarel is no exception. Should the diaphragm rupture in case of transformer failure, greater quantities of moisture have access to the liquid.

Recommended Guide for the Application of Dry Type and Askarel Insulated Transformers.

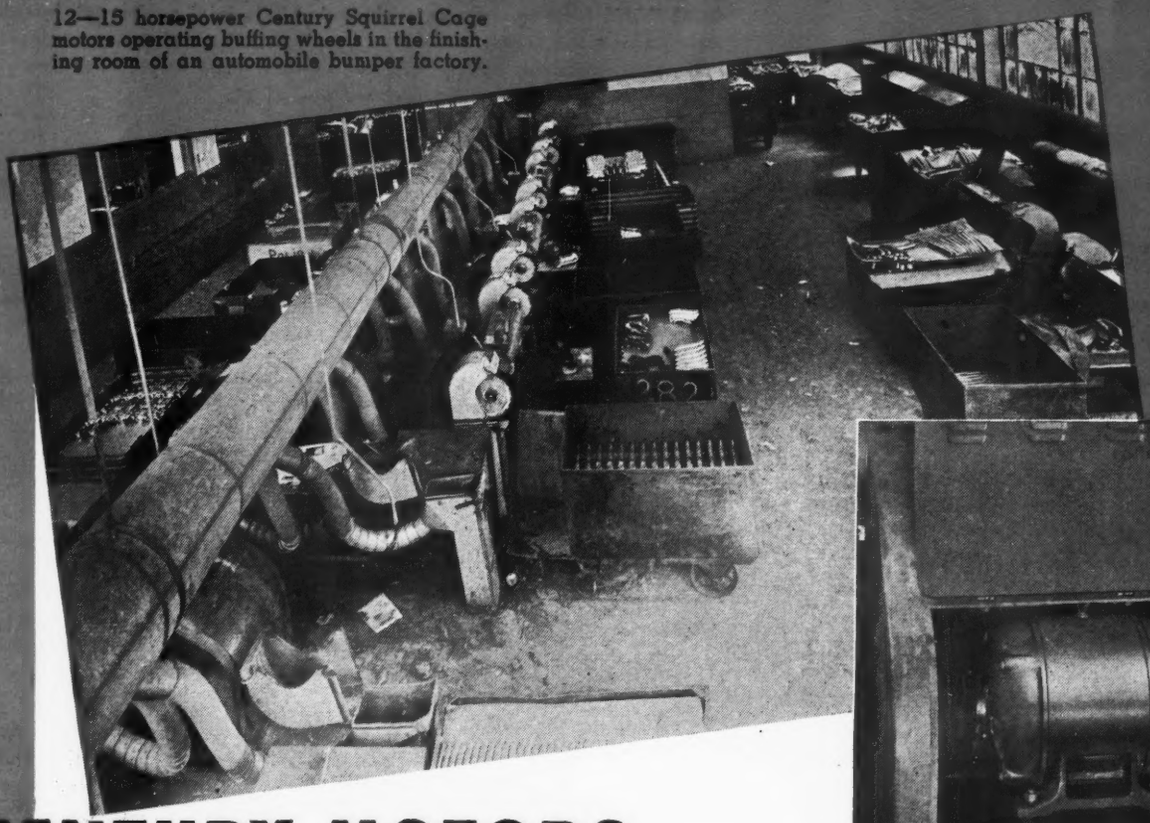
All transformer failures do not result in the extreme conditions outlined above. The most serious consequences usually encountered are the inconvenience and expense of a service outage and the cost of making repairs. Therefore the selection of a transformer for a particular application should be made with some regard for the probable failure producing situations existing in a given application. For example, if the transformer is to be connected directly to overhead lines that are exposed to lightning the more conservative course would be to select the askarel insulated transformer.

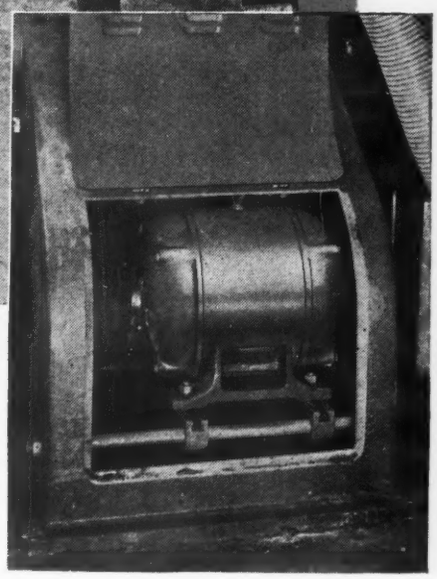
Although many people place greater importance on one or another of the characteristics of dry type and askarel insulated transformers outlined above, in general it is safe to say that either transformer is acceptable barring three exceptions that favor the askarel insulated unit. These three exceptions should be checked for each application before the final selection is made. They are lightning exposure, atmospheric conditions or location and flexibility for use in future changes of the system layout. Based on these three exceptions, the accompanying application chart for indoor installations has been prepared as a condensed guide to assist in the selection of the type of transformer.

Conclusions

Although the guide for the selection of dry type and askarel insulated transformers seems to favor the askarel insulated type, it is quite probable that the majority of applications fall in the area where the three exceptions are not encountered and where either type is equally satisfactory. In this area successful service should be expected from either type provided they are properly maintained. The conditions resulting in the case of failure will probably be of negligible importance in either type, except for the service outage, provided they are backed up with adequate overload protection of suitable sensitivity as dictated by modern practice.

12—15 horsepower Century Squirrel Cage motors operating buffing wheels in the finishing room of an automobile bumper factory.





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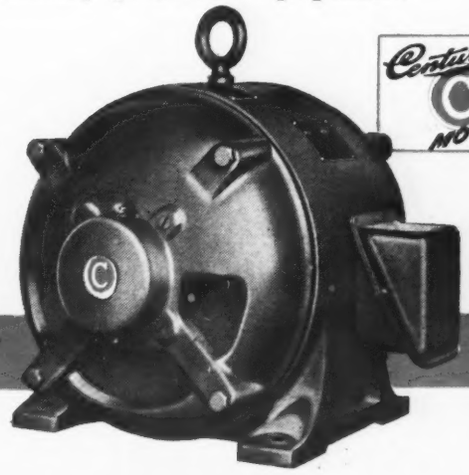

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

Reader's Quiz

Rewound Motor

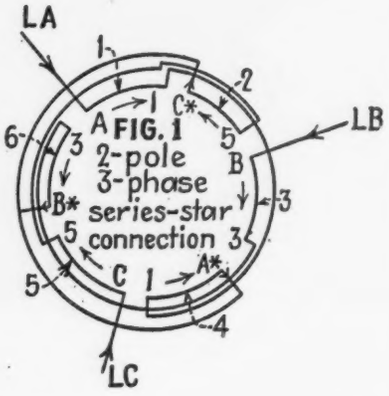
QUESTION 238—We have a 3-phase, one hp., 3600 rpm. motor which had burned out due to grounding. After the motor was rewound and then tested out, everything was all right with the exception that the motor took 3.6 amps., 3.6 amps., and 3.8 amps., respectively per each phase with no load operation which I believe was too high, as the nameplate, showed 3.2 amps. for a full load.

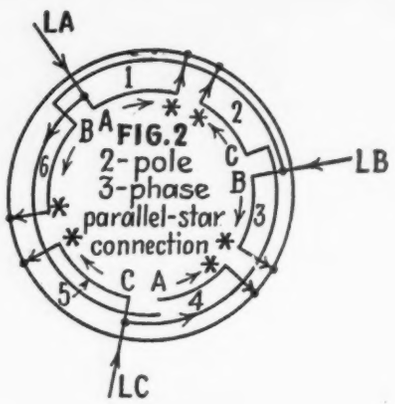
What is wrong? The motor had 48 turns per coil, 24 slots, was connected parallel star, and was rewound the same as the old winding. Could a few turns short per coil be responsible?—E.J.K.

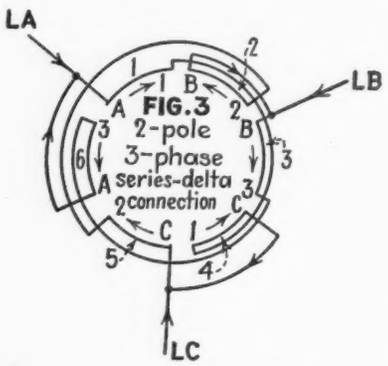
A. TO QUESTION 238—Replying to E. J. K's question, the data furnished is not sufficient to figure a winding for the motor in question. However, from available data, it looks as though the motor in all probability is connected wrong. Most motor windings today are designed for dual voltages—either 110/220 or 220/440 and it is very easy to slip up in checking the connections before stripping.

The difference of .2 ampere on one phase could be due to a discrepancy of turns per coil in that phase but the no-load readings of 3.6 amps., 3.6 amps., 3.8 amps., is entirely too high and indicates that the winding should be connected series star instead of parallel star.

E. J. K. states that the winding is connected 2-parallel star as shown in Figure 2 of the attached diagrams. If the motor is correctly connected as per Figure 2, I suggest that it be reconnected series star, as Figure 1 of attached diagrams, and a load placed on the motor. If the motor will carry 3.2 amperes, full load as stamped, on the data nameplate, without falling below the full load rpm., then the series star connection is the proper connection for the winding. However, if there is too much slip when full load is applied, it is possible that the winding will have to be connected series—delta as shown in Figure 3.—N.H.M.







A. TO QUESTION 238—Assuming that the motor was operating satisfactorily before it was rewound, that the turns were correct and my not knowing just what you consider a few turns; also you have omitted the coil span.

I will endeavor to list a few possible causes of the trouble.

(a) Each turn dropped is considered a voltage change, your amps. raise as a square of your voltage change.

(b) Shorting of your coil span (also considered as same in a).

(c) Mechanical—due to faulty bearings or misalignment of your stator or rotor laminations.

Any one or the combination of all (a) (b) (c) could be the source of the rise in amps. About one amp. should be correct.—L.A.

A. TO QUESTION 238—In answer to E. J. K's question regarding three phase, 1 hp. motor which takes an excessive current, I would say that you will probably find that the trouble is due to excessive high rotor resistance caused by over heating. In all probability this is a rotor with soldered end band connections and the solder has probably been melted due to the high temperature.

If the connections are also bolted, the bolts should be tightened and the connections thoroughly soldered to reduce the resistance and probably cure the trouble.—A.G.S.

A. TO QUESTION 238—If you used same size wire and rewound the same as before the reason for the higher amperage reading is due to not replacing the same number of turns as you removed, that in turn decreased the reactance and impedance, therefore you draw more current.—L.R.T.

A. TO QUESTION 238—Mr. E. J. K. doesn't state whether the phase currents were balanced prior to the burnout, but I shall assume that they were not, due to unbalanced supply voltages. Such a condition would not be unusual and should cause no alarm. Proceeding upon the theory that E. J. K. was a competent winder and rewound the motor exactly as it

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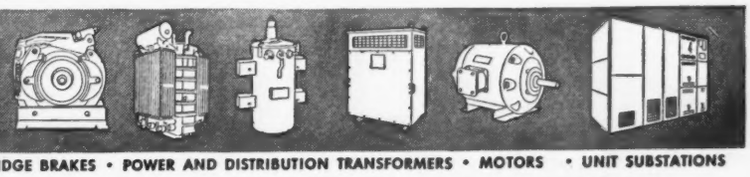

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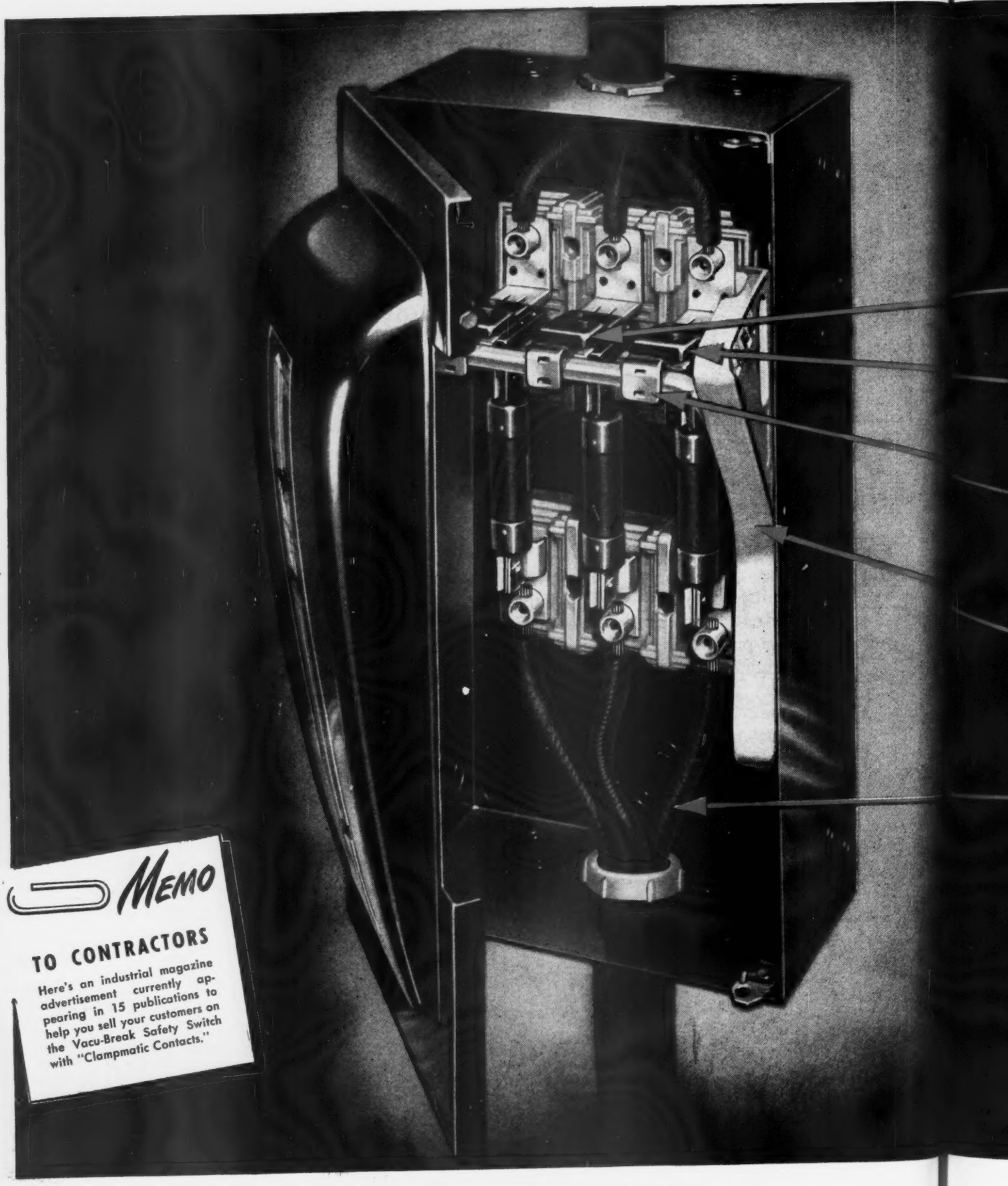

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was wound before the burnout, I suggest that he examine the rotor. It is quite likely that the heat from the burnout caused loose or oxidized connections between the rotor bars and the end rings. This could be easily checked by observing the speed of the motor. If it doesn't approach its rated speed, one can safely assume that the rotor is at fault. An alternative cause of this unbalanced current input could be short-circuited iron laminations in the phase that was originally grounded. This could be located by close inspection of the iron in the stator, and would be evidenced by hot spots when the motor was operated.—W.P.R.

Motors Running Hot

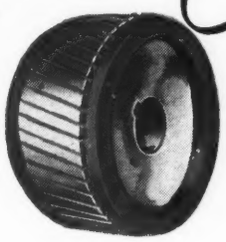
QUESTION 239—I would like to know why ¼ hp. single phase motors seem to run very hot after they are rewound. The current input is still below nameplate reading and speed is normal.

As far as I know, the right number of turns are replaced and the coils are put in their proper slots. The rotors seem to be in excellent condition. Is it possible that an open flame fire on the core to burn out the old winding would have any bad effects on the laminations?—F.F.

A. TO QUESTION 239—The increased heating in rewound ¼ horsepower motors, if the replaced windings were identical and properly connected, can only be the result of iron losses. If, as stated, the old windings were removed by burning, it is quite probable that the laminations no longer consist of soft annealed material. This hardening of the laminations would increase the iron losses on alternating current and this, in turn, would increase the heat loss, resulting in higher operating temperature. It is doubtful if anything can be done short of rewinding after an attempt to anneal the laminations which would be a difficult process. Operation at less than full load or rating the ¼ horsepower down to 1/6 might permit operation without damage. Increased ventilation by applying a more efficient fan on rotor might also help.—W.B.M.

A. TO QUESTION 239—The laminations of an induction motor are made from a special silicon steel designed to reduce the hysteresis losses to a minimum. These laminations are thin and have a very thin coating of insulating compound which insulates them from each other. This coating is to prevent passing of eddy-currents from one sheet to another.

The only motor with a *Copperspun* Rotor



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The characteristics of copper make it the ideal rotor material. Copper has high electrical and thermal conductivity (twice as good as aluminum), greater strength, and low thermal expansion.

The indestructible copperspun rotor, with its better electrical characteristics, puts the Fairbanks-Morse motor far ahead of the times in stamina and ability to meet unusual conditions. Fairbanks-Morse & Co., Chicago 5, Illinois

Every good feature you could ask!

Protected Frame. Excludes dripping liquids and falling particles.

Cross-flow Ventilation. Provides uniform cooling—no hot spots.

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Recessed Conduit Box. Permits neat installations in close quarters. Conventional box also provided.

Adaptability. Frame gives protection in any mounting position.

Balanced Characteristics. A 40° C. motor with high efficiency and power factor, and excellent starting and accelerating torques.

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to make REAL *money*

Electric Motor Distributors everywhere prefer to stock and sell Johnson ELECTRIC MOTOR BEARINGS because the line is complete . . . it's top quality . . . it's *profitable.* Why not secure the franchise for your territory? Write today. Johnson Bronze Company, 490 South Mill Street, New Castle, Pennsylvania.

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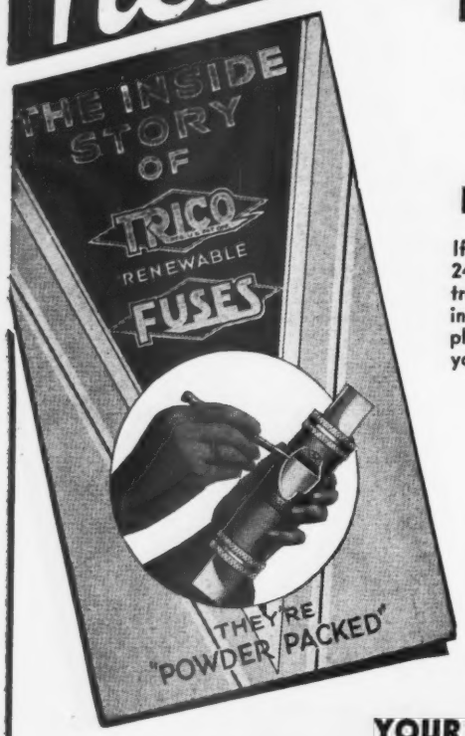

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Tests made by R. C. Clinker show that the hysteresis is increased from 5 to 18% by subjecting this steel to a rise in temperature of 100 degrees C. Burning the insulation out with a flame would probably raise the temperature far above this point and would possibly destroy or carbonize this insulating coat between the laminations. This would allow eddy-currents to flow from one lamination to another. As these eddy-currents run parallel to the winding and at right angles to the laminations, they may now flow the entire length of the stator. This builds up their potential which, with the already reduced resistance between laminations, causes a large eddy-current to flow.

As both hysteresis and eddy-current losses appear in the form of heat, the tendency is for the motor to heat up.

The efficiency of the motor will also be reduced due to the increase in its losses.—A.E.T.

A. TO QUESTION 239—Single phase motors run much warmer than d-c motors of same size hp. and the hand is a very poor indicator of temperature. A motor may feel to be running too hot but still be within a safe temperature. What I would suggest would be a temperature check of the motor by means of a thermometer to see whether it is within the nameplate temperature rise that is permitted.

If a high temperature is indicated and assuming that the rewinding was correctly performed, I would check the rotor bars for poor connections which could easily be caused by the overheating due to a stator burnout. Also check your oil wicks in the bearing housing which becomes charred with motor burnouts. As a general rule, an open flame will do no harm if the laminations do not get red hot from the heat.—E.K.

A. TO QUESTION 239 — The quality of the steel laminations and the temperature reached determine whether the heat applied in burning out the old winding is responsible for the unsatisfactory operation.

The application of an open flame to the extent of reaching annealing temperatures, followed by rapid cooling, may decrease the permeability of the core and increase its hysteresis loss. The same is true for cores of ordinary grade consisting of low carbon open-hearth steel laminations. The high permeability and soft condition of such a core may only be restored by thorough annealing above the critical temperature, known as the Curie point, then cooling at a relatively slow rate. Motors and transformers made of this type of steel develop magnetic fatigue

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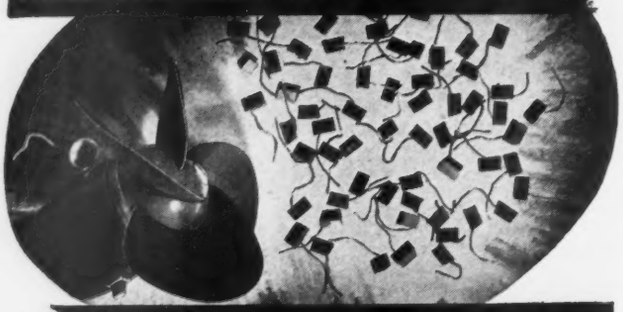

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or aging characteristics manifested by lower permeability and higher hysteresis loss after operating at about 50 degrees Centigrade temperature rise for some time. Operation over extended periods of time at higher temperatures may cause the hysteresis loss to exceed 100 percent of its normal value.

The laminations of high grade electric motors and transformers are, however, made of silicon steel which has substantially non-aging characteristics. A silicon steel core may even be heated to redness and cooled at any desired rate without appreciably decreasing its permeability. Aging is negligible for laminations containing more than about 1½ percent silicon. This alloying element increases resistivity, decreases eddy current and hysteresis losses, and improves the aging characteristics.

All possible sources of electrical and mechanical troubles should be rechecked before ascribing the overheating to the use of open flame in removing the old windings.—R.G.C.

Air Core Solenoids

QUESTION 240 — Will some reader kindly give the formulas or step-by-step procedure used in the design of a-c air core solenoids? By air core I refer to a coil having no magnetic material other than its plunger. I am familiar with the turns-per-volt method, but I am not fully satisfied with the overall efficiency of a coil designed in this manner.—T.B.B.

A. TO QUESTION 240—I refer the writer to the book "Magnets" by Charles R. Underhill and published by McGraw-Hill Book Company, Inc. In this book he will find his question answered along with many other interesting problems pertaining to solenoids and magnets.—G.W.L.

A. TO QUESTION 240 — The efficiency of the coil is not as good as closed magnetic circuits. The coil length has to be not less than 2 or 3 times the diameter. It is easy to make, it will not burn out due to a poor seal in the magnetic circuit, or low starting voltage, or using on d.-c. instead of a.-c. It is high speed, and does not hammer.—H.S.

Lets take a LOOK at the inside of a WARE HI-LAG Renewable FUSE

Double Fibre Bridge Assembly increases strength 10 times Maintains perfect alignment.

Only one wrench needed to remove blown link and renew.

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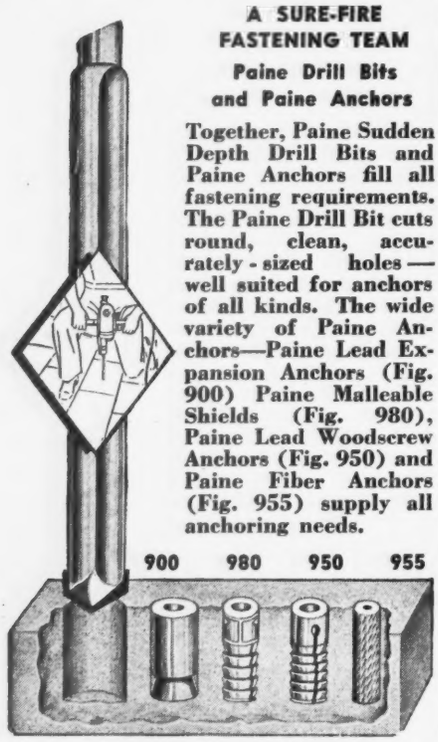

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PAINE FASTENING and HANGING DEVICES

Can you ANSWER these QUESTIONS?

QUESTION A11—I want to connect a current transformer in one leg of a three phase 440 volt line, to control a relay which in turn will open the holding circuit of a large auto starter when the demand peak of the three phase line reaches a range of 500-750 amperes steady pull for at least one minute or longer than the usual duration of high starting currents. Can you give me a formula on the current transformer? What type of relay shall I use? The relay must not operate on the high starting currents, and must have a rheostat or tapped transformer in its holding circuit so as to give variable control. My idea is to establish a certain load peak as our electric bill is partly based on the demand charge.—D. A.

QUESTION B11—We use in our testing work a 3 phase, 4 wire, 120/208 volt recording watt-hour meter.

This instrument has two rotating elements both on the same shaft. There are only two potential coils which are connected between phases A and C and the neutral. There are four current coils, two on each rotating element. Phases A and C pass through one coil each and phase B passes through one coil in each element in series.

I would like to have some of your readers explain how this records the correct wattage on a three phase four wire system.—E.M.

QUESTION C11—I would like to change the speed of a ¼ hp., 110 volt, 1750 rpm., a-c motor, to about half speed or approximately 700 to 900 rpm. Kindly show diagrams.—E.P.R.

QUESTION D11—We have to rewind squirrel cage motors from 25 cycles to 60 cycles.

We know how to figure out number of turns and pitch.

In few cases we did not succeed, and manufacturer of motor said it could not be changed except in keeping number of pole same as on 25 cycles.

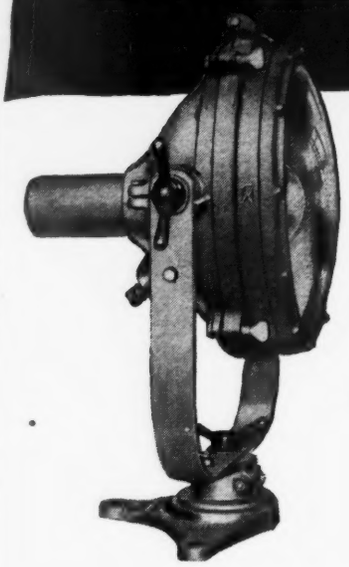
By counting number of bars on rotor and number of slots in stator, could we tell if it could be rewound for a change in number of pole?—H.R.

PLEASE SEND IN YOUR ANSWERS BY APRIL 15

DEPENDABLE

Floodlighting

WITH MINIMUM MAINTENANCE



Pyle-National heavy duty floodlight equipment is built to withstand severe operating conditions; to provide the reliable lighting needed for protection, and for outdoor night work. Pyle-National reflector design and light control lenses assure high efficiency lighting with proper distribution for maximum usefulness. The wide range of types and sizes, from 100 watts to 5000 watts, allows individual requirements to be met easily and economically—substantial weatherproof construction with sealed interior gives maximum protection to reflector and lamp bulbs. Interior cleaning and other maintenance is greatly reduced. Write for Catalog 2100 giving full information, with beam efficiency, candlepower, and light distribution data.

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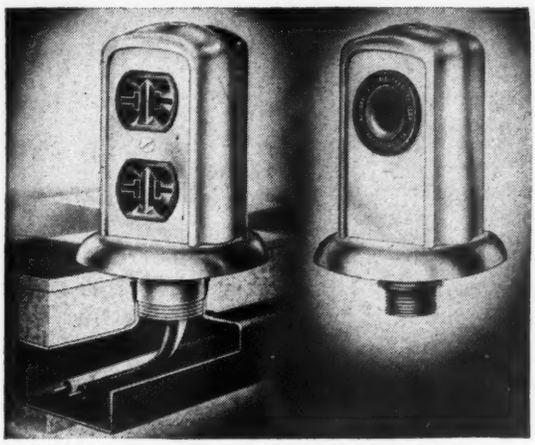
FEDERAL ELECTRIC PRODUCTS COMPANY, MANUFACTURERS OF A COMPLETE LINE OF ELECTRICAL PRODUCTS INCLUDING: MOTOR CONTROLS, SAFETY SWITCHES, CIRCUIT BREAKERS, SERVICE EQUIPMENT, PANELBOARDS

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONSTRUCTION and MAINTENANCE you saw the item and they will send full details to you.

Equipment News

Service Fittings

Two new service fittings for high and low potential wiring designed for use with the Nepcoduct underfloor wiring distribution system have been announced. Fitting No. 7903, with its standard duplex T-slot receptacle, is to be used for high potential light and power wiring. Telephone, buzzer and inter-communication low potential wiring in plant offices and office buildings are serviced at the floor level with Fitting No. 7904. Of the same general appearance and construction, the service fittings are adapted to screw into standard outlets of the underfloor duct. No. 7903 can be furnished with three pole twist-lock receptacles. National Electric Products Corporation, Chamber of Commerce Bldg., Pittsburgh 19, Pa.



NATIONAL ELECTRIC FITTINGS

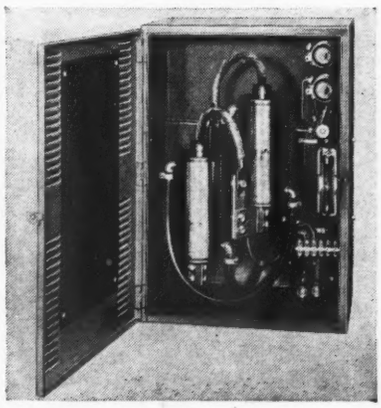
Wire Connector

This new universal "4-in-1" size, solderless and tapeless wire connector eliminates the need of using four sizes, it is claimed. Approved by Underwriters' Laboratories for joining 46 different wire combinations ranging from 2 No. 18 to 4 No. 14 with 1 No. 18 or 2 No. 12 with 1 No. 16, solid or stranded wires. It is designed for making fixture joints, roughin-in joints, sign wiring and joints in electrical equipment and machinery. Holub Industries, Inc., Sycamore, Illinois.

HOLUB WIRE CONNECTOR

Electronic Contactor

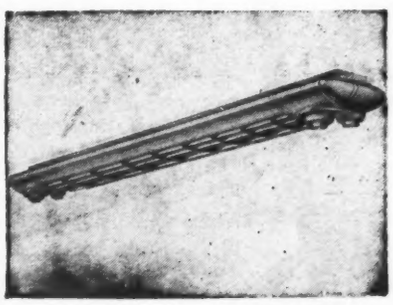
A new line of electronic contactors using ignitron tubes are available for resistance welders. These electronic contactors supplement the syncro-break and high speed magnetic contactors. The design of the new Class 8990 contactors provides increased wiring space with power connections made near the center of the enclosure allowing minimum bending of power cables. Contactor is assembled on a removable steel base plate. All control elements are grouped at the righthand side away from tubes and cables. Flat door construction is used to permit close ganging of contactors and provide maximum utilization of space. Square D Company, 4041 North Richards Street, Milwaukee 12, Wis.



SQUARE D ELECTRONIC CONTACTOR

Store Lighting System

Custom made lighting systems for every type of store are made available through a new line of fluorescent luminaires for general illumination and matching, adjustable, incandescent spotlights for highlighting. Called the Merchandiser, the two or four light units and the two light incandescent spotlighting elements are both complete in themselves. Both the fluorescent and the spotlight units are available for surface and pendant mounting. End caps are available for any arrangement of luminaires. Housings provide ample wireway when units are mounted end to end. Canopy switches can be provided for the spotlight sections so that lights not in use can be turned off. The spotlights are adjustable through an angle of 35 degrees from the vertical and can be rotated through 345 degrees horizontally. Westinghouse Electric Corporation, Pittsburgh 30, Pa.



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Small diameter • Light weight • Natural rubber insulation Perfectly centered conductors • High tensile strength • High dielectric strength • Flame retardant, moisture resistant cover

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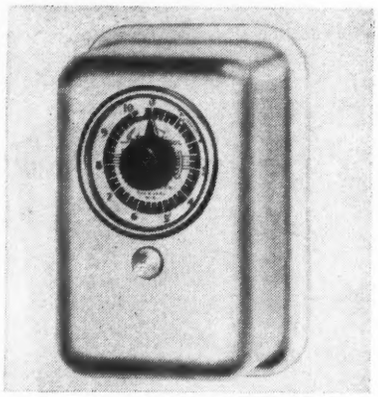
ELECTRICAL WIRES AND CABLES

Attic Fan Timer



PARAGON AF TIMER

Two models of a synchronous motored attic fan timer, capable of pre-setting for any period to 10 or 20 hours respectively by 10 or 20 minute intervals has been announced in this new AF series. The timer is designed to open the fan circuit thus turning off the fan, at the pre-set period. The user may set the switch before retiring and fan will cool the house through the night for any specific time interval. Timers are designed for surface mounting with conduit connection at bottom, or direct to box. They have U.L. approval for 24 volt or 115 volt a-c. Paragon Electric Company, 1614 Twelfth Street, Two Rivers, Wis.

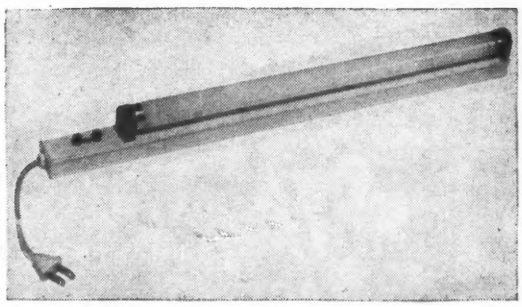
Infra-red Industrial Lamps

G-E INFRA-RED LAMP

Two new 125 watt infra - red industrial lamps have been announced. One is equipped with a G-30 bulb, and is designed especially for use in open reflector ovens. It has a medium skirted base, 5 inch light center length, and fits infra-red reflectors now in general use. The other has an R-40 reflector type bulb and a medium skirted base. Designed to be used interchangeably with the 250 watt and 375 watt G-30 and R-40 lamps, the new models are especially suited to oven applications where it is desired to maintain a given lamp spacing and distribution of radiant energy, but where temperature required is considerably less than that provided with the 250 watt lamps. It is claimed that they have advantages for pre-heating, for balancing temperatures in ovens where an even heat is required, or for use on finishes which might be harmed by a greater energy density. General Electric Lamp Department, Nela Park, Cleveland, Ohio.

Fluorescent Units

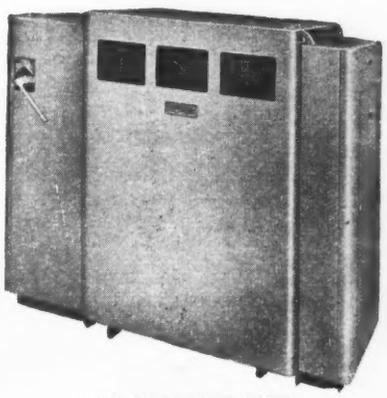
A new line of single and multiple 15 watt fluorescent units, low power factor, 110-125 volt, 60 cycle, have been announced. Wired and ready to install, these No. 21A units are compact, most of the single units being 21 inches long overall. The cross section is $1\frac{1}{4}$ inches wide by $1\frac{1}{8}$ inches deep. Units are furnished with 6-foot cord and plug for plugging into existing outlets; with 6-inch conductor leads coming from end; with adapter plate and conductor leads at back for connecting to outlet boxes; with manual starting switch or with conventional type FS-2 starter switch;



WIREMOLD FLUORESCENT UNIT

with toggle switch on side; or with snap switch and extra receptacle on side. Units are furnished with two No. 2103A clips for permanent or portable mounting. The Wiremold Company, Hartford 10, Conn.

Unit Substation



WAGNER SUBSTATION

High voltage incoming line, transformer, and low voltage feeder sections are combined in one assembly in these new all-in-one unit substations. Unit is completely enclosed, with air-cooled transformer for indoor installation. Noninflammable-liquid-filled or oil-filled self-cooled transformers are also available. Unit substations are standardized in ratings 100, 150, 200 and 300 kva., 3 phase, 60 cycles. Choice of types of transformers and voltage. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis 14, Mo.

Receptacles and Connectors

RUSSELL & STOLL RECEPTACLE

A new line of Ever-Lok receptacles, plugs and cord connectors for 30 amperes, 440 volts a-c has been announced. Units are not interchangeable with other 10 and 20 ampere Ever - Lok equipment. Typical uses are for heavy duty industrial purposes and many other applications. Among the features of this unit are: receptacle has fully protective hinged cover and gasket, solderless terminals with metal shield for protecting terminals; plug contacts are precision-machined; adjustable cord grip; automatic locking. Russell & Stoll Company, Inc., 125 Barclay Street, New York 7, N. Y.

That is fact, not guesswork. An independent national survey of those planning to build new homes for themselves shows that 65% want one or more electric exhaust fans. This means increased business for Electric Contractors. And the electric ceiling ventilator that spells increased profit and customer satisfaction is "Blo-Fan." Here is why:

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3. Blo-Fan occupies only 3½ inches behind the plaster when used in an inside wall.

4. Blo-Fan is the result of 22 years' experience by Pryne and Company in building exhaust ventilators especially for homes.

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★ More than a Fan

★ More than a Blower

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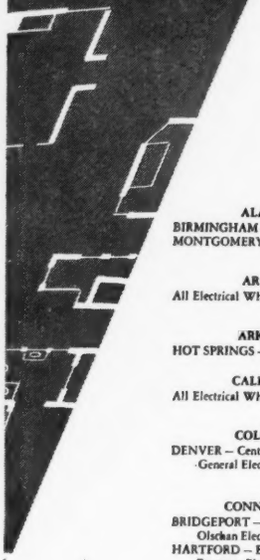

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All Electrical Wholesalers

COLORADO
DENVER — Central Electric Supply Co.
General Electric Supply Corp.

CONNECTICUT
BRIDGEPORT — General Electric Supply Corp.
Olschan Electric Supply Company
HARTFORD — Beacon Light & Supply Co.
Economy Electric Supply Co.
General Electric Supply Corp.
NEW BRITAIN — Spring & Buckley, Inc.
NEW HAVEN — General Electric Supply Corp.
Grand Light & Supply Company
STAMFORD — MarLe Co.
WATERBURY — General Electric Supply Corp.

DELAWARE
WILMINGTON — Art Craft Electric Supply Co.
General Electric Supply Corp.

DISTRICT OF COLUMBIA
WASHINGTON — Columbia Electric Supply Co., Inc.
Fries, Beall & Sharp Co.
General Electric Supply Corp.

FLORIDA
DAYTONA BEACH — Hughes Supply
GAINESVILLE — Baird Hardware Co.
JACKSONVILLE — General Electric Supply Corp.
Hajoca Corp.
Raybro Electric Supplies, Inc.
MIAMI — General Electric Supply Corp.
Raybro Electric Supplies, Inc.
ORLANDO — Hughes Electric Supply
PENSACOLA — Gulf Electric Supply Co.
ST. PETERSBURG — Raybro Electric Supplies, Inc.
TALLAHASSEE — McGowan Electric Supply Co.
TAMPA — General Electric Supply Corp.
Raybro Electric Supplies, Inc.

GEORGIA
ATLANTA — General Electric Supply Corp.
The Electric Supply Co.
AUGUSTA — Hart Electric Supply Co
COLUMBUS — P. & W. Electric Supply Co.
MACON — Lowe Electric Co.

IDAHO
BOISE — General Electric Supply Corp.

ILLINOIS
AURORA — Schomer Electric Supply
CENTRALIA — Travelectric Co.
CHICAGO — Emjay Builders Supply Co.
General Electric Supply Corp.
Revere Electric Supply Co.
DANVILLE — Danville Electric Supply Co.
ELGIN — Fox Electric Supply Co.
JOLIET — Barrett Hardware Co.
PEORIA — Kiefer Electric Supply Co.
QUINCY — Crescent Electric Supply Co.
ROCKFORD — General Electric Supply Corp.
Rock River Electrical Supply Co.
SPRINGFIELD — General Electric Supply Corp.

INDIANA
ANDERSON — Peerless Electric Co.
EVANSVILLE — General Electric Supply Corp.
FT. WAYNE — General Electric Supply Corp.
National Mill Supply Co.
INDIANAPOLIS — General Electric Supply Corp.
Peerless Electric Supply Co.
KOKOMO — Wholesale Electric Service
LAFAYETTE — Kirby Risk Electric Co.
MARION — Universal Electric Co.
MUNCIE — General Electric Supply Co.
Universal Electric Co.
SOUTH BEND — South Bend Electric Co., Inc.
TERRE HAUTE — Walker Electric Supply Co., Inc.

IOWA
BURLINGTON — Crescent Electric Supply Co.
CEDAR RAPIDS — Van Meter Co.
DAVENPORT — Crescent Electric Supply Co.
DES MOINES — General Electric Supply Corp.
DUBUQUE — Crescent Electric Supply Co.
FT. DODGE — Iowa Electric Supply Co., Inc.
MASON CITY — Crescent Electric Supply Co.
SIOUX CITY — Crescent Electric Supply Co.
WATERLOO — Crescent Electric Supply Co.

KANSAS
SALINA — Electric Fixture & Supply Co.
Lee Hardware Co.
TOPEKA — Kansas Electric Supply Co.
WICHITA — American Electric Co.
Heaven Engineering Co.

KENTUCKY
LOUISVILLE — General Electric Supply Corp.
Tafel Electric & Supply Co.
LEXINGTON — General Electric Supply Corp.

LOUISIANA
BATON ROUGE — Electrical Wholesalers, Inc.
NEW ORLEANS — General Electric Supply Corp.
Lighting Fixture & Electric Supply Co.
SHREVEPORT — General Electric Supply Corp.
Interstate Electric Co., Inc.

MAINE
LEWISTON — Lewiston Hardware & Plumbing Supply Co.
PORTLAND — General Electric Supply Corp.

MARYLAND
BALTIMORE — Dorman Electric Supply Co.
Excello Public Service Corp.
General Electric Supply Corp.

MASSACHUSETTS
BOSTON — General Electric Supply Corp.
Mass. Gas & Electric Supply Co.
BROCKTON — Mass. Gas & Electric Supply Co.
CAMBRIDGE — EMF Electric Supply Co.
FALL RIVER — Brady Electric Supply Co.
FITCHBURG — Service Electric Supply Co.
LAWRENCE — Dyer-Clark Co.
LYNN — Essex Electric Supply
MALDEN — Mass. Gas & Electric Supply Co.
NEW BEDFORD — Electric Service & Sales Co.
QUINCY — Granite City Electric Supply Co.
SPRINGFIELD — Carlisle Hardware Co.
General Electric Supply Corp.
WALTHAM — Waltham Supply Co., Inc.
WATERTOWN — Mass. Gas & Electric Supply Co.
Watertown Electric Supply Co.
WORCESTER — Atlantic Electric Supply Co.
General Electric Supply Corp.

MICHIGAN
BATTLE CREEK — Central Electric Supply Co.
BAY CITY — Meisel Hardware & Supply Co.
DETROIT — General Electric Supply Corp.
Madison Electric Co.
FLINT — Royallte Co.
GRAND RAPIDS — Electric Supply Co.
General Electric Supply Corp.
KALAMAZOO — General Electric Supply Corp.
Electric Supply Co.
LANSING — General Electric Supply Corp.
Michigan Brass & Electric Co.
MUSKEGON — Fitzpatrick Electric Supply Co.
PETOSKEY — Bremmeyr-Bain Co.
PONTIAC — Standard Electric Co.
SAGINAW — General Electric Supply Corp.
Morley Brothers
Standard Electric Co.

MINNESOTA
DULUTH — General Electric Supply Corp.
MINNEAPOLIS — General Electric Supply Corp.
Northland Electric Supply Co.
Sterling Electric Co.
ST. PAUL — Electric Supply Co
Farwell, Ozmun, Kirk & Co.
General Electric Supply Corp.

MISSISSIPPI
JACKSON — Electric Supply Co.
General Electric Supply Corp.

MISSOURI
JOPLIN — General Electric Supply Corp
KANSAS CITY — General Electric Supply Corp.
Glasco Electric Co.
Heaven Engineering Co.
SPRINGFIELD — General Electric Supply Corp.
Heaven Engineering Co.
ST. JOSEPH — American Electric Co.
ST. LOUIS — General Electric Supply Corp.
Glasco Electric Co.

MONTANA
BUTTE — General Electric Supply Corp.
GREAT FALLS — Falls Supply Co.

NEBRASKA
CHADRON — Casper Supply Co.
LINCOLN — Korsmeyer Co.
OMAHA — General Electric Supply Corp.
SCOTTSBLUFF — Casper Supply Co.

NEW HAMPSHIRE
DOVER — Ralph Pill Electric Supply Co.
MANCHESTER — Granite State Electric Supply Co.
General Electric Supply Corp.

NEW JERSEY
ASBURY PARK — Rale Electrical Supply Co.
BLOOMFIELD — Bloomfield Electric Supply Co., Inc.
CAMDEN — Borstein Electric Co.
ELIZABETH — Jersey State Electric Co.
HACKENSACK — Lowenthal Electric Supply Co.
HOBOKEN — L & G Laikin
MORRISTOWN — Morristown Electric Supply Co.
NEWARK — Reliable Electric Supply Co.
Star Electric Supply Co.
NEW BRUNSWICK — New Brunswick Electric Supply Co.
ORANGE — C. M. Lantz
PASSAIC — National Electric Co.
Simon Brothers Electric Co.
PATERSON — Watson-Flagg Sales Corp.
White & Shauger, Inc.
PHILLIPSBURG — Warren Electric Supply Co.
PLAINFIELD — Hi-Fro Electric Supply Co.
TRENTON — Griffith Electric Supply Co.
UNION CITY — Hudson Electric Supply Co.

NEW MEXICO
ALBUQUERQUE — General Electric Supply Corp.
J. Korber & Co.
State Electric Supply Co.
SANTA FE — Santa Fe Builders Supply Co.

NEVADA
RENO — J. R. Bradley Co.

NEW YORK
ALBANY — Havens Electric Co., Inc.
BINGHAMPTON — Gould-Farmer Co.
Wehle Electric Co., Inc.
BROOKLYN — G. M. Ketcham Mfg. Corp.
BUFFALO — Davis Electric Supply Co.
General Electric Supply Corp.
Kenmore Builders Supply Co., Inc.
Wehle Electric Co., Inc.
ELMIRA — Wehle Electric Co., Inc.
GLENS FALLS — Glens Falls Electric Supply Co
ITHACA — Stallman of Ithaca
JAMAICA — Central Queens Lighting Fixture Corp.
KINGSTON — Kolts Electric Supply Co.
MT. VERNON — B. Davis
P. G. Supply Co.
NEW YORK CITY — General Electric Supply Corp.
Hirschfeld Electric Supply Co., Inc.
NIAGARA FALLS — General Electric Supply Corp.
OLEAN — LeValley-McLeod-Kinkaid Co., Inc.
POUGHKEEPSIE — Electra Supply Co.
ROCHESTER — General Electric Supply Corp.
S. A. Spencer
Wehle Electric Co., Inc.
ROME — Griffith Electric Supply Co.
SCHENECTADY — LeValley-McLeod-Kinkaid Co.
SYRACUSE — Edward Joy Co.
Gould-Farmer Co., Inc.
YONKERS — Goler Electric Supply Co.

NORTH CAROLINA
BURLINGTON — Womack Electric & Supply Co.
CHARLOTTE — General Electric Supply Corp.
GREENSBORO — Johannesen Electric Co., Inc.
RALEIGH — Scott Parish Electric Supply Co.
WINSTON-SALEM — Lambeth Electric Supply Co., Inc.

NORTH DAKOTA
FARGO — Dakota Electric Supply Co.
MINOT — Dakota Electric Supply Co.

OHIO
AKRON — General Electric Supply Corp.
Sacks Electric Supply Co.
CANTON — Furbay-Sommer Co.
General Electric Supply Corp.
CINCINNATI — General Electric Supply Corp.
Richards Electric Supply Co.
CLEVELAND — General Electric Supply Corp.
Midland Electric Co
COLUMBUS — General Electric Supply Corp
Howard Bldg. Service Company
COSHOCTON — Wagner's
DAYTON — General Electric Supply Corp.
Martin Electric Co.
LANCASTER — Snyder Electric Co.
LIMA — Electric Supply Co.
TOLEDO — Anderson & Krapp
General Electric Supply Corp.
YOUNGSTOWN — General Electric Supply Corp.
Hood Electric Co.

OKLAHOMA
MUSKOGEE — Fullerton Electric Supply
OKLAHOMA CITY — Cook Electric Supply Co.
General Electric Supply Corp.
TULSA — General Electric Supply Corp.

OREGON
All Electrical Wholesalers

PENNSYLVANIA
ALLENTOWN — Allen Electric Co.
General Electric Supply Corp.
BLOOMSBURG — E. R. Beers Electric Co.
BRADFORD — Booth Electric Co.
CHESTER — Reddington Electric Co.
ERIE — General Electric Supply Corp.
HARRISBURG — Dauphin Electric Supplies Co.
LANCASTER — Jno. E. Graybill & Co.
MEADVILLE — Harley D. Carpenter
NEW CASTLE — Bruce Electric Supply Co.
OIL CITY — Corrin Electric Supply
PHILADELPHIA — Taylor Albertson Co.
Broad Electric Supply Co.
General Electric Supply Corp.
W. Phila. Electric Supply Co.
PITTSBURGH — L. Paul O'Hara
READING — General Electric Supply Corp.
SCRANTON — General Electric Supply Corp.
WEST CHESTER — West Chester Elec. Supply Co.
WILKES-BARRE — General Electric Supply Corp.
YORK — Jno. E. Graybill & Co.

RHODE ISLAND
PROVIDENCE — General Electric Supply Corp.
Royal Electric Supply Company

SOUTH CAROLINA
CHARLESTON — Perry-Mann Electric Co.
COLUMBIA — Perry-Mann Electric Co.
SUMTER — Sumter Machinery Co.

SOUTH DAKOTA
ABERDEEN — Dakota Electric Supply Co.
RAPID CITY — Casper Supply Co.
SIOUX FALLS — Crescent Electric Supply Co.

TENNESSEE
CHATTANOOGA — General Electric Supply Corp.
Ramsey Electric Supply Co.
KNOXVILLE — General Electric Supply Corp.
Roden Electric Supply Company
MEMPHIS — General Electric Supply Corp.
NASHVILLE — General Electric Supply Corp.
Harris-Patrick Electric Supply Co.

TEXAS
ABILENE — General Electric Supply Corp.
Sun Electric Co.
AMARILLO — General Electric Supply Corp
AUSTIN — Southern Electric Supply Co.
BEAUMONT — General Electric Supply Corp.
CORPUS CHRISTI — Corpus Christi Hardware Co.
DALLAS — General Electric Supply Corp.
Smith-Perry Electric Co.
EL PASO — General Electric Supply Corp.
FT. WORTH — General Electric Supply Corp.
Smith-Perry Electric Co.
HARLINGEN — Bush Supply Co
HOUSTON — General Electric Supply Corp.
Southern Electric Supply Co.
Warren Electric Co.
LUBBOCK — General Electric Supply Corp.
Southwestern Electric Supply Company
SAN ANTONIO — General Electric Supply Corp.
Southern Equipment Company
WACO — General Electric Supply Corp.

UTAH
SALT LAKE CITY — General Electric Supply Corp
United Electric Supply Co.
Westinghouse Electric Supply Co.

VERMONT
BURLINGTON — Vermont Hardware Co

VIRGINIA
DANVILLE — Womack Electric & Supply Co
LYNCHBURG — Mid-State Electric Supply Co.
NORFOLK — General Electric Supply Corp.
Goodman Electric Supply Company
RICHMOND — General Electric Supply Corp
Tower-Binford Electric & Mfg. Co.
ROANOKE — General Electric Supply Corp

WASHINGTON
SEATTLE — All Electrical Wholesalers
SPOKANE — Columbia Electric & Mfg. Co.
General Electric Supply Corp.
Inland Electric Co.
Westinghouse Electric Supply
TACOMA — All Electrical Wholesalers
WALLA WALLA — Electric Supply & Fixture Co.
YAKIMA — Inland Pipe & Supply Co.

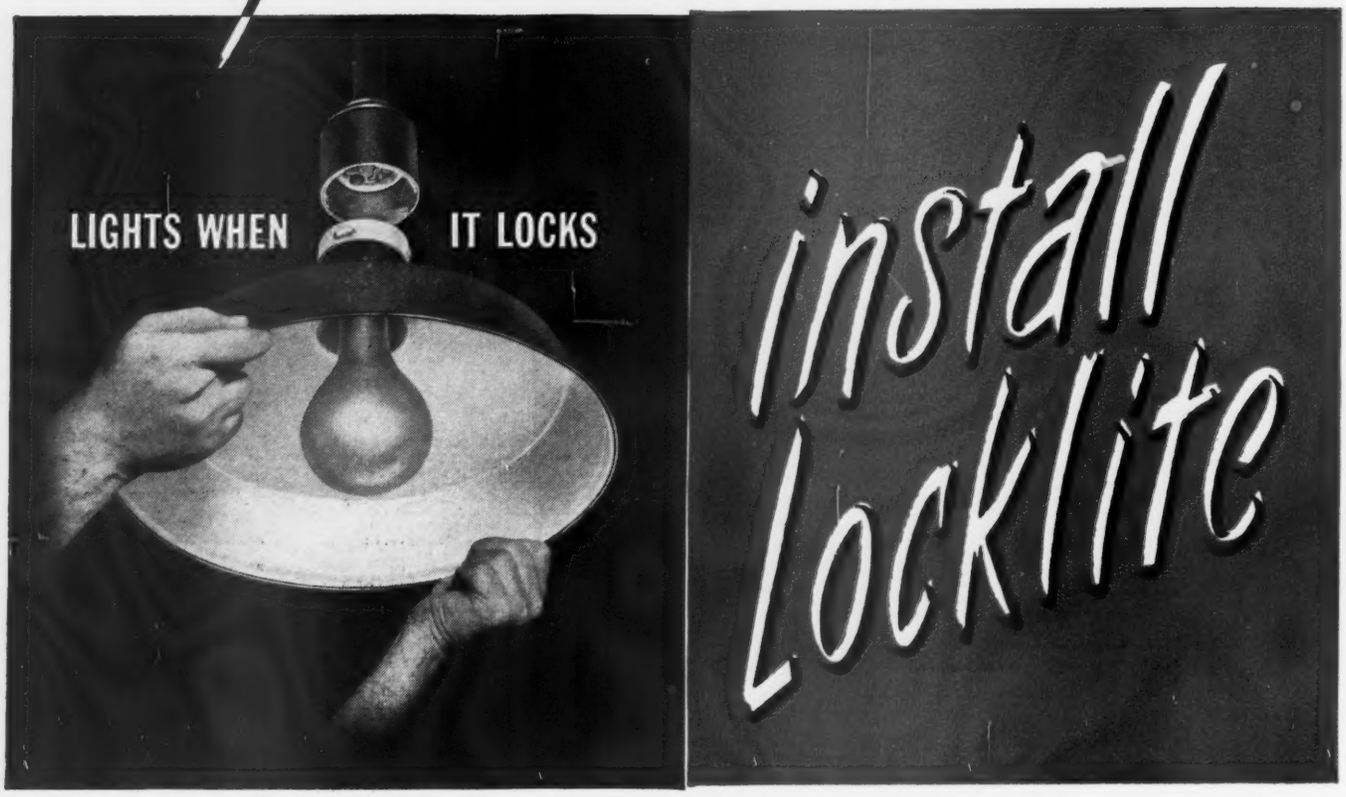
WEST VIRGINIA
CHARLESTON — Virginian Electric, Inc.

WISCONSIN
APPLETON — General Electric Supply Corp
FOND DU LAC — Central Electric Supply
GREEN BAY — Murphy Supply Co.
LA CROSSE — General Electric Supply Corp.
W. A. Roosevelt Co.
MADISON — Crescent Electric Supply Co.
MANITOWOC — Rahr's Inc.
MILWAUKEE — Builders' Specialties, Inc.
General Electric Supply Corp.
OSHKOSH — Electrical Contractors Supply
SHEBOYGAN — Honold & La Page, Inc.

WYOMING
CASPER — Casper Supply Co.
CHEYENNE — Casper Supply Co.
LARAMIE — Casper Supply Co.
SHERIDAN — Casper Supply Co.
WORLAND — Casper Supply Co.

NEW YORK • CHICAGO • HOUSTON • SAN FRANCISCO

for "30-second maintenance..."



Five Types of Reflectors Available with Locklite Features

You can have higher lighting efficiency—with lower maintenance cost—by using Locklite . . . an exclusive Westinghouse design that *lights when it locks.*

It's easy to install. In 30 seconds, with a twist of the wrist, it may be removed, wiped clean and replaced. No tools are required. The hood accommodates either medium or mogul size reflectors and lamps. This means maximum flexibility to meet changing lighting requirements in your plant—without changes in wiring.

For information, see your nearest Westinghouse distributor. Or write for B-3604, "A Guide to Better Industrial See-ability". Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-04108

Motor Shops

Reconversion Starts With Oven

Reconversion of the 50-year-old South Park Foundry and Manufacturing Company, South St. Paul, Minn., includes a new baking oven, sand mullers, rattling machines, jolt rollovers, electric cranes, elevators and cupola. Molds baked by the foundry are used for castings, tractors, scales, motor work and bell housings. Considerable interest has been shown in the improved baking results since former curing resulted in approximately 7½ percent rejects, high fuel costs and large consumptions of core oil.

The new batch type core-baking oven, a product of the Despatch Oven Company, Minneapolis, has boosted production 500 percent, has created savings of 20 percent in core oil, has reduced fuel charges over 30 percent and has eliminated the rejection of green, uncured cores. A flexible panel construction permits bringing the large oven unit through an ordinary doorway in sections for assembly inside. The panel construction was also appreciated in shipping, erection and moving. The oven, direct gas-fired, is also available as an oil-fired or electric unit and a selection from 64 manufactured sizes handles cores or molds of a wide variety.

C. D. Pruden, vice president and manager of the South Park organization, states that the oven has resulted in absolute uniformity of product, increased capacity by stepping up baking cycle speeds, easy installation, clean cores and core room, and automatic operation.

Batch type baking oven installed by South Park Foundry of Minneapolis is part of expansion and modernization program. Panel construction permitted bringing sections through standard-width doorways and erecting oven in place. Installation resulted in uniformity of product, increased capacity and automatic operation. Core oil and fuel charges were cut while rejects due to green cores were eliminated.

Planned Salvage Reconditions Coils

When reconditioning large size motors, considerable critical copper stock and resultant expense can be saved by carefully inspecting the material removed from the damaged unit and reconditioning those parts which have not been structurally or physically weakened. The present scarcity of large quantities of coil bar stock makes this salvage approach particularly applicable to the question of coils.

In the shop of the Everson Electric Company, Allentown, Pa., bar coils are carefully removed and inspected. They are dipped in a hot caustic bath to remove damaged insulation and then are scraped and straightened. After annealing, the leads are buffed and tinned and the coils are then re-formed to the contour of the slots. To insure straightness of the portions to rest in slot sections, the coils are pounded with a soft-headed mallet in a die. Individual wires are insulated with glass tape and completed coils are overall taped in conformity with the

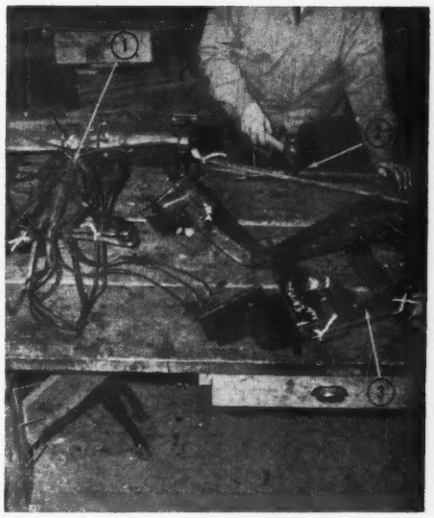


FIG. 1—Original coils of rectangular bar stocks are removed (1) and examined prior to reconditioning operations. Later steps in the salvage program include straightening with hammer and die (2) and forming in iron frame (3)) to insure proper shape of finished coil.

FIG. 2—Coils constructed of lighter, new wire, are checked for slot size, shape and end lengths in hard maple frames. All frames are constructed in the Everson shop.

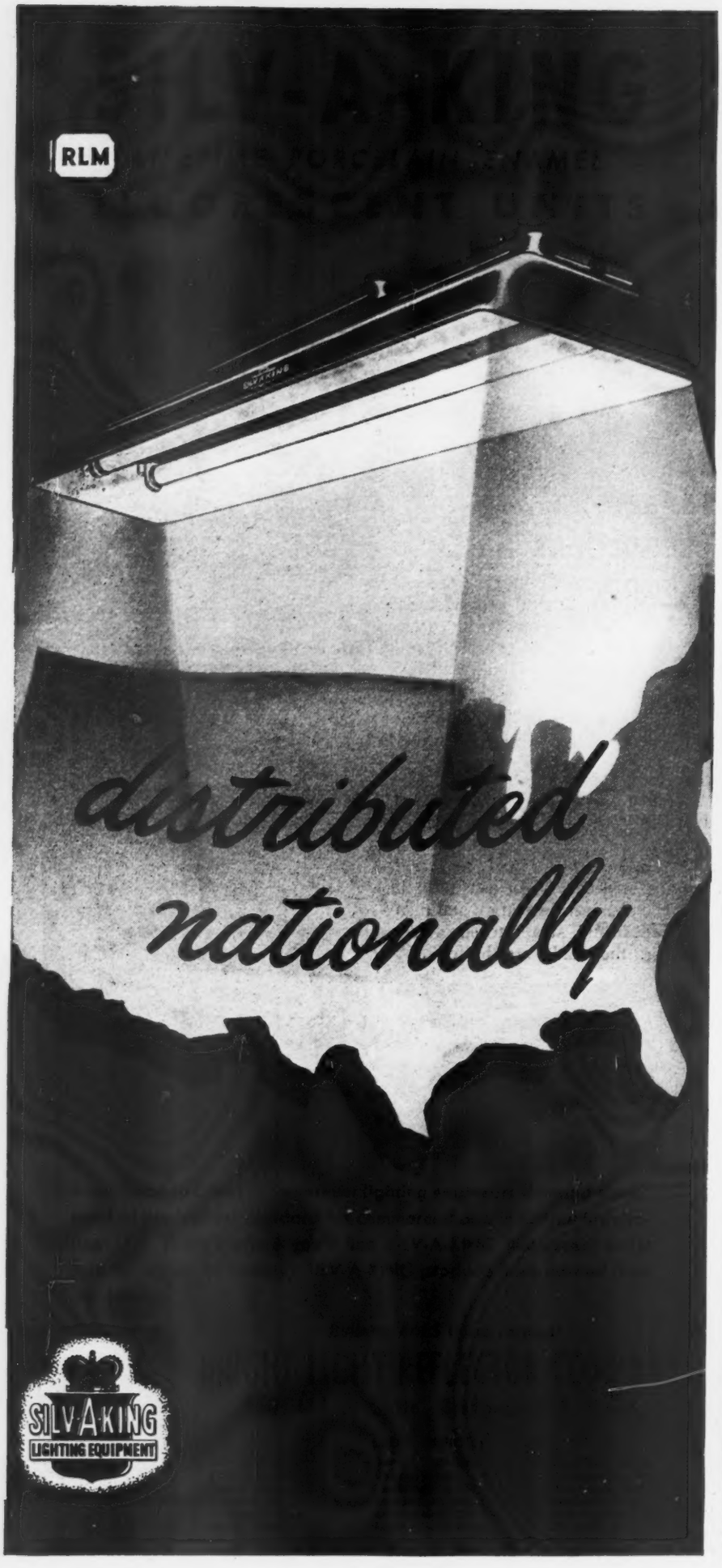


FIG. 3—F. G. Bachman, vice president in charge of production, keeps a personal check on the coil frames and forms in the stock area.

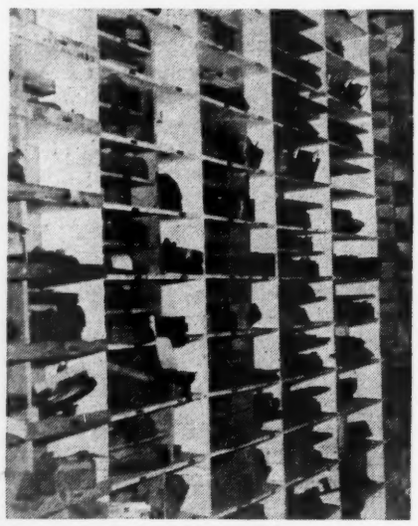
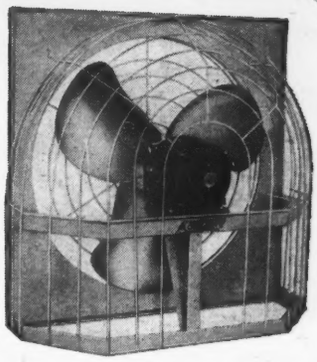


Fig. 4—More than 1200 forms of iron, fibre and hard maple insure exactness in reproducing and reconditioning coils for any motor in common use.

temperatures and severity of service to which the motor will be subjected. Coils are finally dipped in impregnating varnish, baked and inspected for slot size, shape and end lengths. To properly insure exactness of coil form, the Everson organization has in stock over 1200 forms of steel, fibre and hard maple which are used for re-forming and checking the shape and dimensions of the final coils. Their inventory of coil forms is separated into divisions, indicating the original motor manufacturer, the frame number or designation, horsepower and rpm. of the motor, number of coils required per set, the classification of insulation specified by NEMA standards, the wire size and number of turns per coil. Their stock lists are also cross-referenced under their own catalog numbers and the original manufacturers part number.

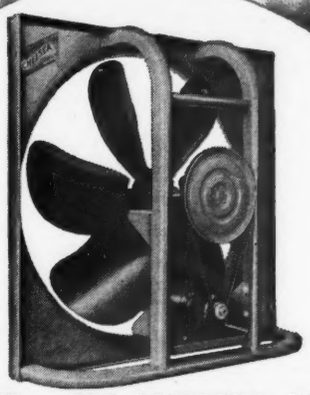
CHELSEA FANS & BLOWERS

...provide clean, fresh circulated air...



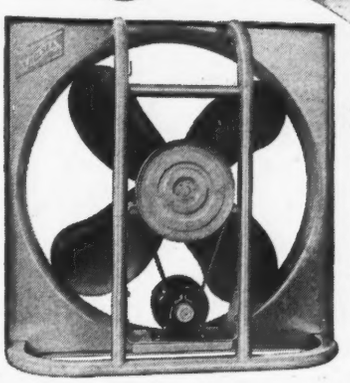
TYPE AA—FOR FOOD FREEZER, MEAT PACKING & STORAGE PLANTS

High air moving capacities . . . Dependable, economical, ball bearing, totally enclosed motors . . . Ratings up to 4800 CFM . . . Front and rear guarded.



TYPE IND—FOR FACTORIES, LOFTS, SPORTS ARENAS, LARGE AREAS

Heavy duty ventilators for air blast action . . . Rugged construction . . . High efficiency ratings to operate against static pressures. Ball bearing motors and drives.



TYPE ED—FOR HOMES, SCHOOLS, CHURCHES, HOSPITALS, INSTITUTIONS

Quiet operation combined with high air deliveries . . . Rugged, streamlined construction . . . Rubber cushioned against vibration. Low power consumption.

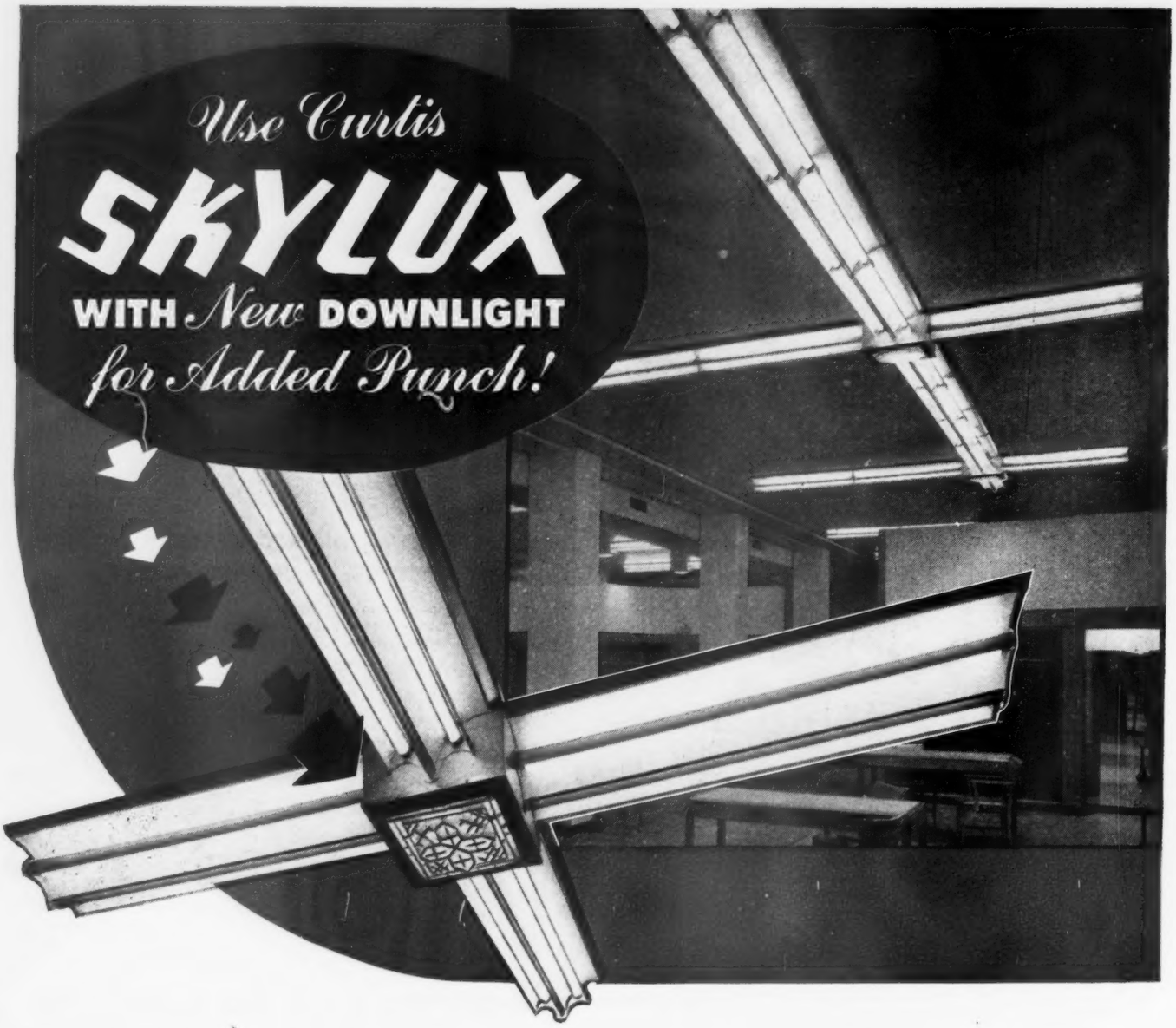
Winter or summer, Chelsea ventilating units help make the day's activity more comfortable, more healthful, more profitable. User acceptance of these efficient air movers is a direct result of Chelsea design and range of models . . . a fitness for the job that makes every Chelsea fan deliver extra measures of satisfactory operation. Featured in most models are rugged, all-steel construction . . . dynamically balanced blades . . . efficient, cool-running motors and drives . . . rubber cushioned moving parts . . . Get the details on the Chelsea line NOW. Chelsea fans are in great demand; early orders mean early deliveries!

...wherever people live, work, play or gather!

CHELSEA

CHELSEA PRODUCTS · INC.

FACTORIES: COIT, GROVE & OLSEN STS., IRVINGTON, NEW JERSEY



INTRODUCING INCANDESCENT SURFACE LUMINAIRE NO. 2230

Always a versatile and efficient unit, Skylux gains added selling as well as additional lighting punch when used with No. 2230 downlights.

This square incandescent surface luminaire can be used anywhere in a continuous line of Skylux to provide increased down lighting . . . over desks . . . over counters . . . over displays. No. 2230 is an ideal unit to match up transverse with longitudinal lines of Skylux . . . or it can be used to create interesting ceiling patterns such as squares, crosses, L's, T's, etc.

Twin Skylux units can be bolted to any or all of the four sides of the No. 2230. A decorative pattern hinged louver shields the 200 or 300-watt incandescent lamp. Maintenance and lamp replacement are easily and quickly accomplished.

Write today for full details on No. 2230 to accompany your present data file on the Skylux.

CURTIS *Lighting*, INC.

6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

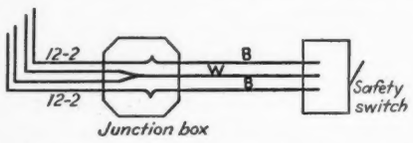
Answered by
F. N. M. SQUIRES and GLENN ROWELL
New York Board of Fire Underwriters
Chief Inspector
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

Multi-Wire Circuit

Q. *Is it permissible to run a No. 12 three conductor cable from a switch box to a junction box to feed two No. 12 two wire branch circuits?* —R.T.D.

A. This is permissible providing the supply is a three wire system as indicated in the accompanying sketch. The Code reference to this is



Section 2104. Note particularly the second sentence in this section which recognizes the multi-wire circuits.—F.N.M.S.

Conductors

Q. *We are preparing to wire a good size store building in which the total connected load will be about 800 amperes. We had planned to parallel three 500,000 CM cables but find that all we can get is some 2/0 type R. Is there any reason why we could not parallel six of these conductors?*—D.B.

A. Section 3105 of the N. E. Code will limit the number of No. 2/0 conductors to be paralleled to four. However, this same section also provides that where special permission has been granted by the inspection authority having jurisdiction other combinations may be used. In view of the present condition, I believe you would be justified in asking for special permission to run the six conductors in multiple. This same section limits the number of conductors run in multiple as follows: "Not more than 3 No. 1/0, four No. 2/0 nor five No. 3/0 to 500,000 CM conductors inclusive may be run in multiple."—G.R.

Non-Metallic Sheathed Cable

Q. *May I run non-metallic sheathed cable (No. 14-2) along the outside of building under the eaves of the roof to connect to overhead wires that go to the barn? This will feed from a switch inside the kitchen to operate a yard light on a three-way operation. Will I be required to run BX?*—R.T.D.

A. Non-metallic sheathed cable was designed as an interior wiring material and was not designed for exposed exterior work.

The Code however, does not definitely prohibit its use as indicated in the question above. Cable run along under the eaves of a house would certainly be exposed to dampness at times but not to dampness *and* at the same time "mildly corrosive fumes and vapors" as mentioned in Rule 3362 (7).

It would seem from the wording of the above rule that the use of this cable would not be prohibited where a small amount of moisture and no corrosion fumes were present. In all probability, however, most inspection bureaus would undoubtedly rule against its use out of doors so our best advice would be not to use it for exterior work.—F.N.M.S.

Show Window Lighting

Q. *I have been asked to OK the plans for an electrical installation in a new store building which does not include show window lighting circuits. The architect claims that such circuits are an unnecessary waste of materials as his client will not need them and he has therefore left them out of his specifications. As yet I have been unable to obtain a copy of the new Code, but I understand some changes have been made concerning the rules covering show window lighting. Will you please explain the changes that have been made so that I can either approve or reject this proposal?*—C.K.

A. The 1947 edition will not make it mandatory to run show window lighting circuits to windows where lighting outlets are not required, but section 2203-b will require that the feeder capacity include a carrying capacity of not less than 200 watts per linear foot of show window measured horizontally along its base. This requirement is made to assure feeder capacity sufficient to provide show window circuits at some later time. Under section 2116 the following requirements covering branch circuits for show window lighting are found: "For show window lighting a load of not less than 200 watts for each linear foot of show window, measured horizontally along its base, may be allowed in lieu of the specified load per outlet." Under the old code the word "shall" was used making it mandatory. Therefore under the new rule branch circuits need not be run to show windows if there are no outlets needed there, but the service and feeders to point of distribution must have ample capacity to provide 200 watts per linear foot of window whether or not such outlets are actually furnished and installed in the original installation.—G.R.

Class I Location

Q. *Is the furnace room of a building in which natural gas is used as a fuel a Class 1 location?*—A.M.S.

A. This question should be answered by the chairman of the Article 500 Committee, or by the Official Interpretations Committee because the Code actually will define this as a Class 1 Division 2 location. Section 5004-b states that locations where

AIR
in motion . . .

. . . keeps MEN *in motion*

Stagnating production frequently is the result of stagnant air. You'll find daily output of your factory, office or mill benefited when you provide workers with fresh, clean, invigorating air. Moreover, you'll likely find the cost of Emerson-Electric exhaust fans repaid by improved Employee Relations. In the interest of quality production and greater plant harmony, get full information on Emerson-Electric fans at once. Survey your buildings and write direct to us or consult your local Emerson-Electric dealer to suggest the most efficient and economical Emerson-Electric exhaust equipment for your particular air-moving job.

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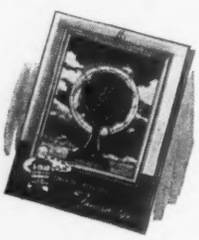
Especially prepared as helpful guide to busy executives interested in plant improvement. Contains full product information, specifications and reference material for plant engineers. Shows typical installations in foundries, machine shops, lofts, show rooms, stores, etc. Send for your copy of catalog No. 508 today.



THE EMERSON ELECTRIC MANUFACTURING CO. • ST. LOUIS 21, MO.
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EMERSON EMERSON ELECTRIC **ELECTRIC**
MOTORS · FANS — APPLIANCES

flammable gases are handled, processed or used but in which these gases are normally confined within closed systems from which they can escape only in case of accidental rupture or breakdown of such systems are Division 2 locations. Then in a fine print note under this section it exempts locations containing only piping without valves, checks, meters or similar devices. Inasmuch as gas piping supplying furnaces contains valves, meters and pressure control devices, such a location is not exempted by the Code. It would, however, be rather difficult to call the basement of gas heated homes Class 1 Division 2 locations, hence the belief that this question should be submitted to the proper committee.—G.R.

Hot Wiring

Q. *What kind of wiring is acceptable in the State of New York when buried in concrete, in which radiant panel heating is also installed? The temperature of the heating pipes in the concrete will be as high as 120° F. What type of wiring will be necessary to resist this temperature?*—F.H.B.

A. The State of New York has no separate electrical code of its own. The National Electrical Code is accepted and enforced by practically all Inspection Bureaus in New York State, the only exception being the City of New York, the Code of which has the same ruling on the above question as the N.E.C.

Under the National Electrical Code either rigid conduit or electric metallic sheathing could be installed in the floor slab the latter only where not subject to mechanical injury. The only difference on this kind of a job and the ordinary poured concrete job, is in the selection of the wires to be used on account of the heat.

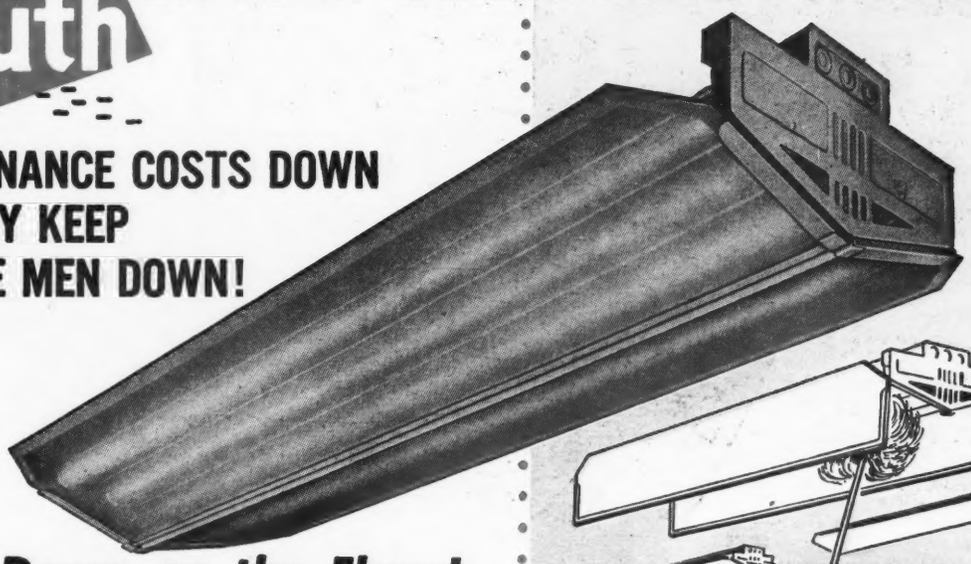
On account of the higher temperatures to which the wires are subjected, we must bear in mind that we have to revise the normal carrying capacities of the wires. The carrying capacities of wires given in Table 1 of the Code are based on a temperature of 86°F but at 122°F the 1946 Type R and also Type T wire will be derated to 58 percent of its normal carying capacity and Type RH wire will be derated to 75 percent normal capacity. Type TA (thermal plastic-asbestos) wire, would be derated to 80 percent of its normal capacity. For instance at 120°F No. 14 wires would have the following carrying capacities:

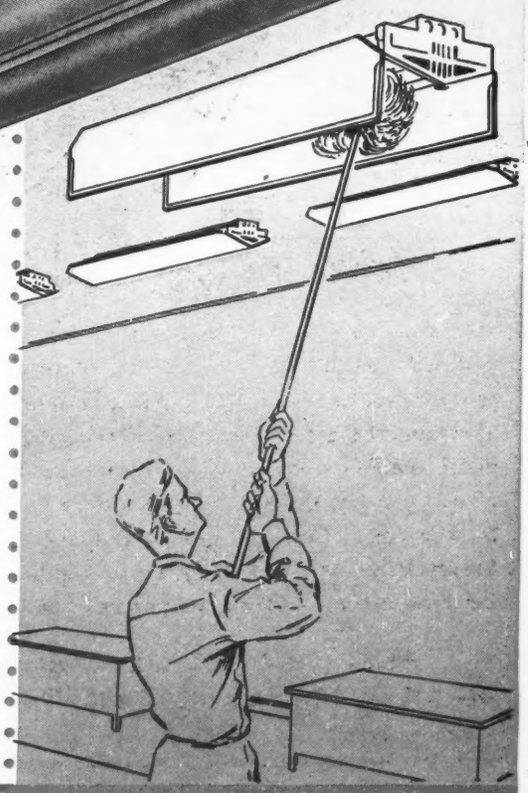
Type R	(1946)	about	9½	amps.
" RH	"	"	11	"
" TA	"	"	20	"

—F.N.M.S.

The New Guth HINGED GLASS ARISTOLITES

KEEP MAINTENANCE COSTS DOWN BECAUSE THEY KEEP MAINTENANCE MEN DOWN!





Yes, Right Down on the Floor!

Fluorescent Luminaires must be cleaned regularly because accumulated dirt can cut light output as much as 50%. With ordinary Fixtures, the cleaning operation is slow, awkward, time-consuming. Maintenance Men drag ladders all over the premises, disturb workers, waste time and energy climbing up and down.

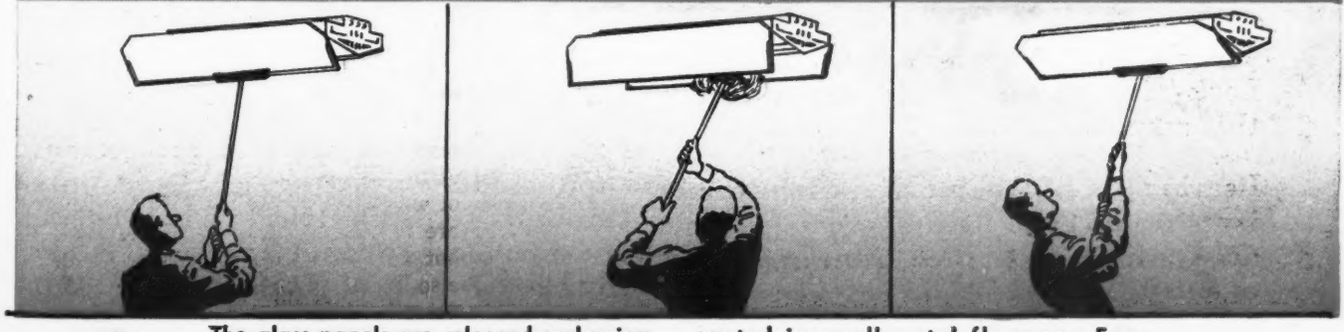
With the new GUTH Hinged Glass ARISTOLITE*, the entire operation can be performed *from the floor!* A simple gripper on the end of a pole swings the glass panels free, a duster on the opposite end of the same pole cleans the Fixture, and the panels are then quickly replaced and securely seated.

The new GUTH Hinged Glass Aristolite, like its famed predecessor, the standard Aristolite, provides fine diffused Fluorescent illumination which makes for safe, comfortable, easy *seeing.* In addition the Hinged Aristolite provides safe, comfortable, easy *maintenance,* too!

It's the Fixture that's serviced in a minute . . . serviced RIGHT . . . right from the floor!

*Trade Mark Registered—Patents Pending

MINUTE-MAINTENANCE WITH THE NEW Guth HINGED GLASS ARISTOLITES



The glass panels are released and swing open on their hinges. A quick dusting restores lighting efficiency to the Fixture. The glass panels lift back and are seated in small metal flanges. For relamping, one trip up the ladder replaces the customary three or four. Less time . . . more safety!

OUR 45th ANNIVERSARY YEAR

Write today for full information that tells how the New Hinged Glass Aristolite can reduce maintenance time and costs.

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Guth Leaders in LIGHTING SINCE 1902

NO Compromise with Quality

You electrical contractors who use T&B Lock-Tite Pressure Connectors have this assurance:

Bearing the T&B name, these high quality wire and cable fittings are today, and always have been, free from any trace of substitute material.

Even during the stress of war production when manufacturers' quality was sometimes slighted, T&B quality standards held true to form.

Play safe. Use our Underwriters Laboratories' Approved Lock-Tite Pressure Connectors on every job where you want to enhance your reputation for dependable electrical installations.

For your convenience and protection, supplies of our fittings are sold only through T&B Electrical Wholesalers, one of whom is near at hand, and ready to take care of you. Ask him for T&B Lock-Tite Bulletin 64.

The Thomas & Betts Co.
INCORPORATED
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1898
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In Canada: Thomas & Betts Ltd. Montreal

NEW LITERATURE

Latest catalogs and bulletins of manufacturers are available to you without cost through this Electrical Construction and Maintenance Reader Service

(1) FLUORESCENT FIXTURES—Bulletins 10-B-1 and 10-B-2 cover the revised listings of Viz-Aid and Topnotch fluorescent commercial lighting fixtures, giving physical dimensions, mounting details, cross-section diagrams, illumination characteristics and applications. Day-Brite Lighting Inc.

(2) TACHOMETERS — New models of speed indicators for speeds up to 100,000 rpm. are discussed in 4-page bulletin. Also included is discussion on vibrating-reed tachometers. James G. Biddle Co.

(3) SCAFFOLD — Adjustable, quickly erected scaffolding pictured and discussed in folder giving erection details, dimensions, construction and uses. Bil-Jax Mfg. Co.

(4) BUS DUCT—Air cooled feeder circuits and flexible plug-in power for branch circuits is subject of 2-color 24-page booklet which discusses Lo-X, distribution systems, construction, applications, fittings and special features. Bulldog Electric Products Co.

(5) BRUSHES—Motor and generator brushes and carbon products are included in catalog 25. Table of contents includes dry cell battery and radio carbon brushes, contacts, specialties, radio tube anodes, packing rings and welding products. Speer Carbon Co.

(6) COLOR CONDITIONING—A new 32-page booklet in full color illustrates and describes the research and experience with color to increase production, improve seeing conditions and create better environments for workers. Three-dimensional seeing treatment of machines is depicted with color photographs of actual installations. E. I. duPont de Nemours and Co. Inc.

(7) MOTOR CONTROLS—New 124-page catalog with listings of motor controls, manual and magnetic starters, push button stations and enclosed switches. Arrow-Hart and Hegeman Electric Co.

(8) CONNECTORS—Pocket-size 52-page catalog covering all popular types of electrical connectors for contracting and industrial maintenance requirements contains specifications for lugs, links, taps, flexible connectors and tools. Burndy Engineering Co. Inc.

(9) CONTROL SYSTEMS—Remote indicating and control systems are explained in 12-page engineering bulletin with construction details. Designed as a d-c device but can be operated on a-c by adding rectifier. Allis-Chalmers Mfg. Co.

(10) TACHOMETERS — Bulletin 1810 gives uses, types, specifications, prices and ranges of vibrating reed tachometers. The principles, construction, accuracy, method of reading and mounting details are discussed. James G. Biddle Co.

(11) LAMP BULLETIN — New 76-page technical treatise, G-E Bulletin LD-1, contains complete data on incandescent, mercury and fluorescent lamps. Latest developments and practical applications in commerce, industry and the home are discussed. Over 40 lamp topics. General Electric Company.

(12) CABLE INSTALLATION — Underground and aerial cable installation

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equipment and safety devices in illustrated booklet. Cable benders, dressers, feeders, pulling rigging, racks and arms; jacks, ladders; manhole steps, cover hooks and guards; rods, signs and tents are listed. T. J. Cope, Inc.

(13) A-C Welders — Construction details, electrical specifications and application data on complete line of a-c welders contained in booklet B-3548. Westinghouse Electric Corp.

(14) Reflector Lamps—Nine types of reflector lamps for industrial, commercial, store, theater and display lighting illustrated in bulletin 101 including neck-silvered directs and concentrates, side-silvered tubulars and a variety of floods and spots. Lustra Corp. of America.

(15) Wire Duct—Complete information regarding 4 by 4 Wirewa enclosed metal duct for housing wires and cables describes component parts and methods of installation. National Electric Products Corp.

(16) Insulation Characteristics — Technical publication 21T4 discusses Temperature-Resistance Characteristics of Electrical Insulation with emphasis placed on insulation constants, dielectric absorption and practical methods for obtaining temperatures. James G. Biddle Co.

(17) Synthetic Insulation—Discussion on comparative analysis of natural and synthetic rubber, typical compounds used for insulation and specifications for heat-resistant, ozone-resistant and low-water-absorbing insulations. Simplex Wire and Cable Co.

(18) Hack Saws—Folder lists hack saw blades and band saws including power machine blades, special steel blades, prices and suggested uses. G. W. Griffin Co.

(19) Cold Cathode — Construction and mounting details, light characteristics and utilization data contained in folder on commercial and industrial cold cathode lighting. General Luminescent Corp.

(20) Voltage Control — Bulletin illustrates and describes line of variable transformers, voltage regulators, a-c power supplies, remote positioners and theater dimmers. Superior Electric Co.

(21) Motor Generators—High-current, low-voltage motor generators and other electrical equipment (frequency changers, industrial dynamometers and synchronous motors) included in 4-page folder. Electric Products Co.

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(24) Glow Light — Two-color file-size sheet describing 0.1-watt glow light used as pilot light, test light and built into new design of volt meter. Industrial Devices, Inc.

(25) Capacitors — Bulletin SPD-110 gives full details of new aluminized paper capacitors for use in miniature electronic and radio equipment. Solar Manufacturing Corp.

(26) Mirror-Lights—Deluxe edition of 24 pages includes photographs, drawings and discussion on construction and applications of flexible and rigid cables holding small inspection lights and mirrors. Van Wagner Co.

(27) Hydraulic Power Tools — Porto-Power Catalog discusses portable hydraulic power tools. Jack equipment and pipe benders used for maintenance, production and laboratory work included in 24 page booklet. Blackhawk Mfg. Co.

(28) Fluorescent Lights—Description, prices and photographs of fluorescent desk, bed, bath, kitchen, commercial and industrial lamp fixtures. William Decter, Inc.

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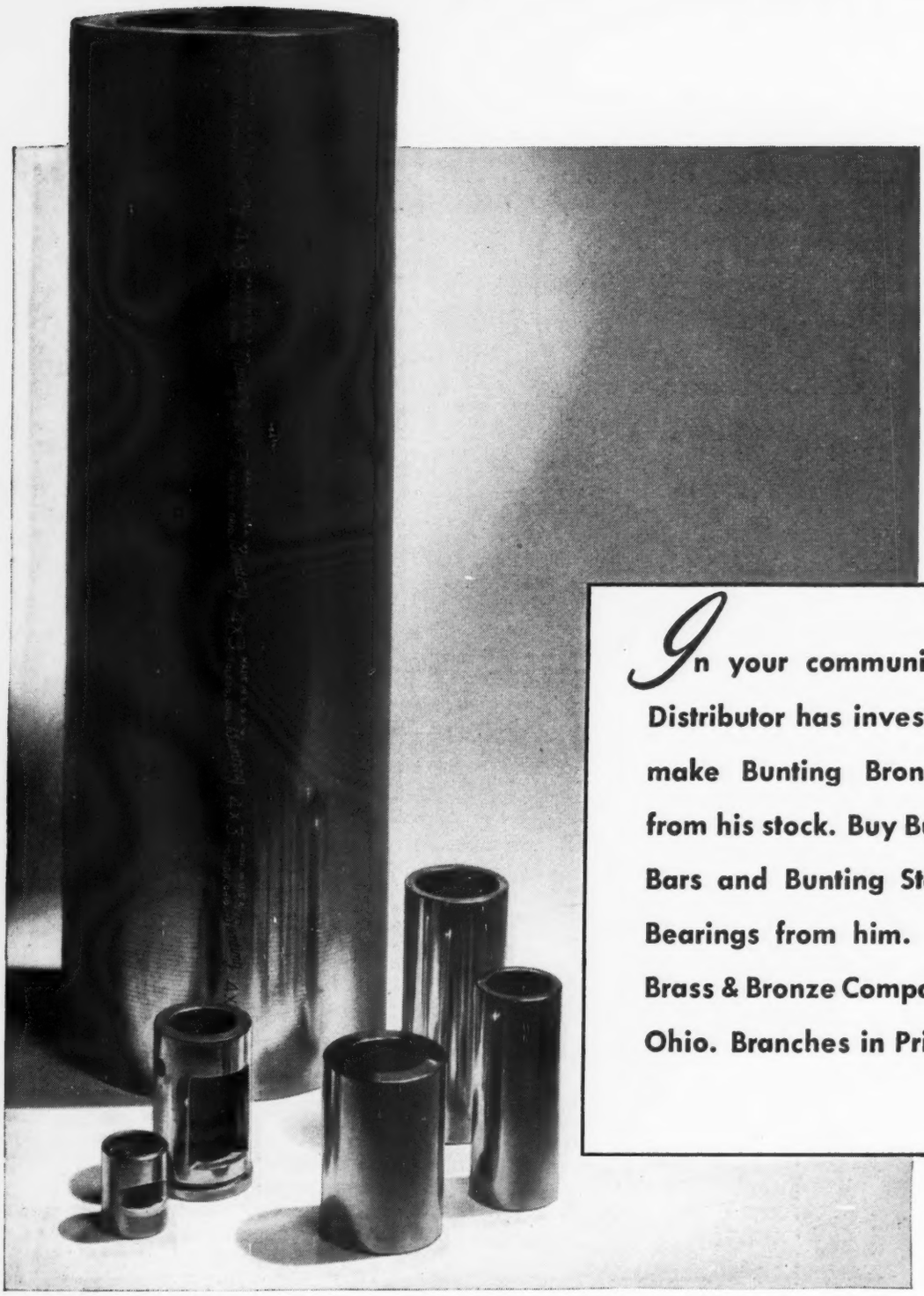

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BRONZE BEARINGS ☆ BUSHINGS ☆ PRECISION BRONZE BARS

VIZ-AID...

22 "Knockouts" on every chassis... How easy to install!

You'll find one wherever you need it . . . and all wire feeds are ready-bushed. All holes and knockouts are die-stamped in one operation for perfect alignment.

VIZ-AID commercial fixtures . . . for continuous or unit mounting . . . surface or suspension . . . two 40- or two 100-watt lamps. U. S. Patent Nos. D-138990, D-143641, and 2411952. Request Bulletin 10-B-1 for complete details.

Day-Brite Lighting, Inc., 5405 Bulwer Ave., St. Louis 7, Mo.
Nationally distributed through leading electrical supply houses.

In Canada: address all inquiries to Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

IT'S EASY TO SEE WHEN IT'S

DAY-BRITE Lighting

296

Modern Lighting

Unequal Spacing Provides Uniform Lighting

Wall areas, including windows, absorb light. Lighting intensities near walls are thus lower than intensities in the center of the room. Most lighting engineers recognize this fact, but seldom do anything to compensate for it, especially in large office areas.

Engineers for the Buildings Management office, Public Buildings Administration, Federal Works Agency, Washington, D. C. have solved this problem on one of their recent relighting jobs. The office space involved is the photogrammetry and drafting room, occupied by the Hydrographic Office, Navy Department, Suitland, Md. This office is operated on a 24-hour workday basis.

The original lighting installation in this area was far from adequate in providing a quality and uniformity in illumination required for the visual tasks involved. Intensities as low as nine footcandles on the working plane were provided by 300 watt totally indirect lighting units located on 10-foot centers. Because of this low intensity, supplementary lighting from fluorescent desk lamps was used on each drafting table (Fig. 1).

The photogrammetry and drafting room is rectangular-shaped, with a gross area of 6000 square feet, consisting of 15 bays formed by columns spaced on 20-foot centers. The ceiling height is 11 feet 6 inches, and is of concrete construction. Formerly the ceiling was finished a light buff color. The resulting coefficient of utilization for the indirect lighting was very low.

In order to provide illumination suitable for the visual tasks involved in this area, it was decided to remove the existing fixtures and install continuous row luminous indirect fluorescent lighting equipment. All except 24 of the 60 existing ceiling outlets were blanked. A total of 44 new outlets were provided, and fed from the 24 old outlets used. Eleven 96-foot long continuous row fluorescent units were installed, and each length wired for four separate circuits. Each row was suspended 24 inches from the ceiling, and contained two parallel continuous rows of 40 watt, 48 inch, 3500°

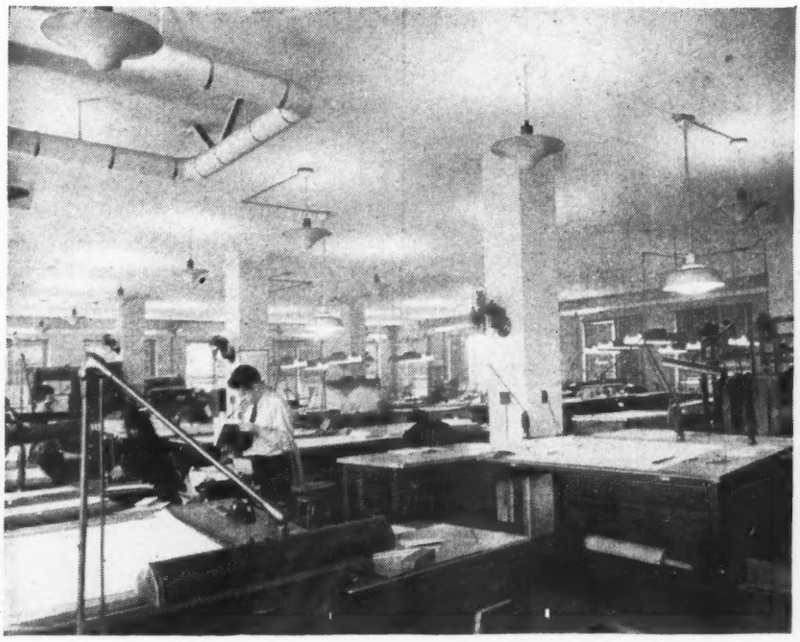

Fig. 1—General view of photogrammetry and drafting room, Hydrographic office, Navy Department, Suitland, Md., showing old indirect lighting system for general illumination which required supplementary lighting.

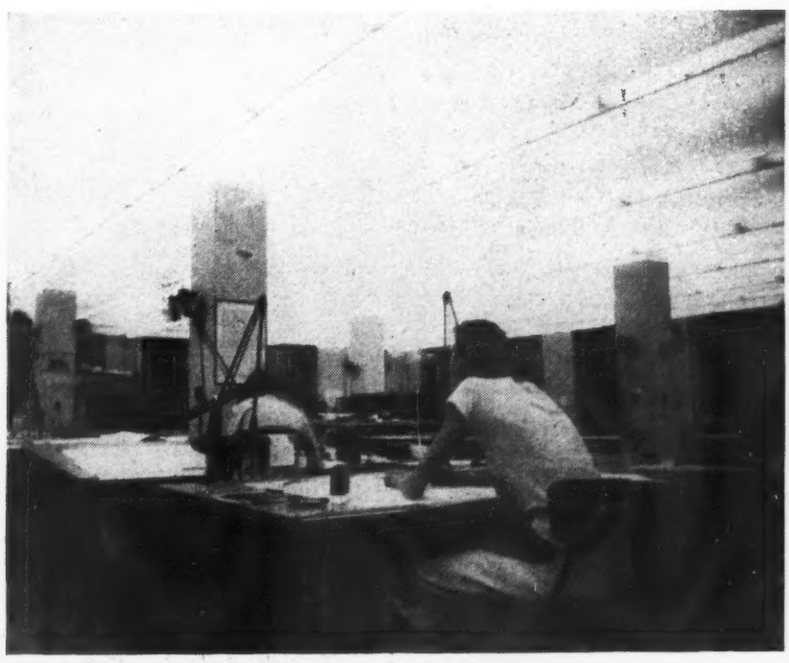

Fig. 2—Same room relighted with Ainsworth continuous row fluorescent lighting. Note uniformity of illumination throughout room.

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- P&S Porcelain Socket Interior.
- Die-cast Metal Shell — Baked-on Aluminum Spray Finish.
- 90° Angle Cap for ½" Conduit — Easily Installed.
- 2¼" Hooded Shadeholder for Shallow Bowl or Dome Type Reflectors.
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PASS & SEYMOUR, INC.
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white fluorescent lamps, shielded by plastic reflectors.

In order to provide for maximum light utilization, the ceiling and walls down to the window soffits, and top of columns down 24 inches, were painted two coats of matte white finish. An unequal spacing of rows of units was used, varying from 4-ft. 3-in. between the two outside rows to 6-ft. 6-in. between rows in the center of the room. This unequal spacing (Fig. 3) piles up more light near the walls, which absorb part of the light reflected to it from the ceiling, with the result that the illumination level is maintained at approximately the same value across the entire width of the room.

Illumination values were measured after the installation had been in continuous 24-hour daily use for three months. The measurements were made in accordance with Illuminating Engineering Society recommended practice for measuring and reporting on illumination values, and showed an average of 70 footcandles. The minimum and maximum values were 64 and 74, showing an unusual uniformity.

Brightness measurements were also taken, and indicate that the installation approaches the theoretical ideal of uniformity or brightness.

Readings were as follows:

Standard	83 f. l.
Working plane	81 f. l.
Over fixture on ceiling	168 f. l.
On ceiling between rows	100 f. l.

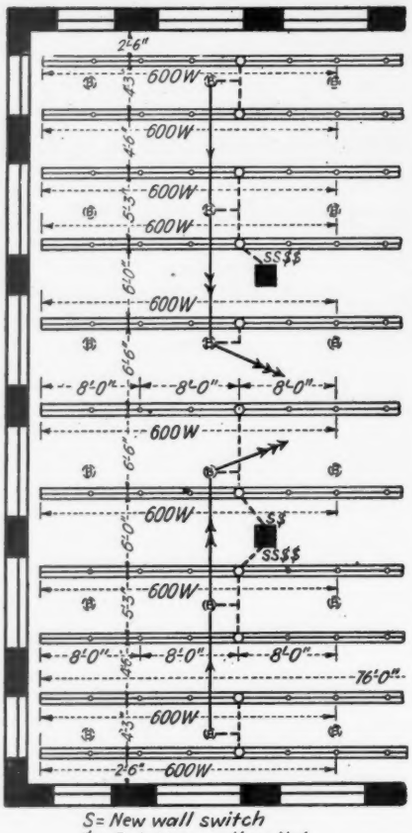
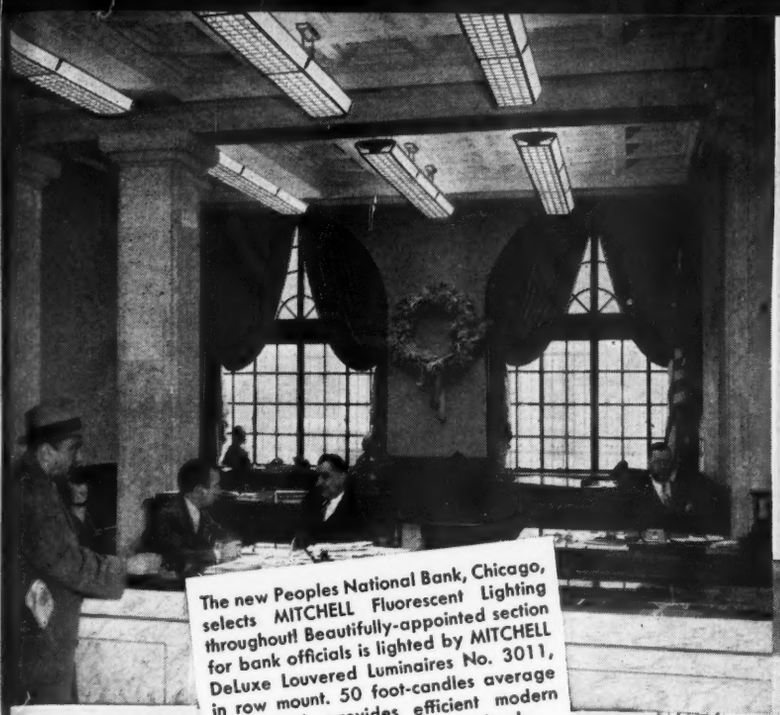


Fig. 3—Eleven 96-foot long continuous rows of fluorescent luminous indirect units are spaced unequal, to provide more light at wall line where walls absorb part of it.

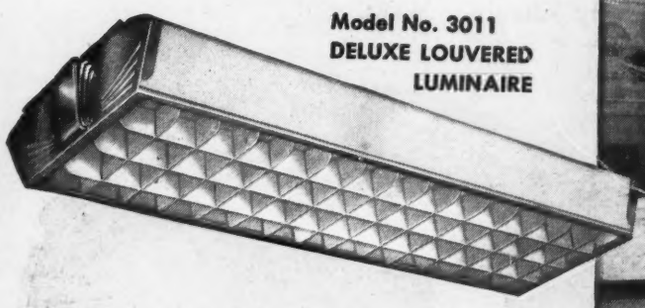
High intensity, evenly distributed fluorescent illumination is featured in this general office lighting system at United Drug Company's St. Louis, Mo., plant. Continuous rows of Joleco four-lamp, 40-watt units with a double-V diffusing glass shield are rod-suspended (17½-inches) on 10 foot centers. Four of the six rows contain 39 units each; two rows, 34 units each. Each fixture contains two 40-watt, 3500-degree white lamps (space provided for two additional lamps). System, with light colored ceiling and pastel green walls and columns, provides average maintained intensity of 50 footcandles. One pull-chain switch controls a group of six units.

MITCHELL

Better Light for Better Banking



The new Peoples National Bank, Chicago, selects MITCHELL Fluorescent Lighting throughout! Beautifully-appointed section for bank officials is lighted by MITCHELL DeLuxe Louvered Luminaires No. 3011, in row mount. 50 foot-candles average maintained; provides efficient modern lighting for an efficient modern bank.



Model No. 3011
DELUXE LOUVERED LUMINAIRE

Main banking floor of the Peoples National Bank . . . completely lighted by MITCHELL No. 3011 Luminaires. In spite of the lofty ceiling, an average of 40 foot-candles is maintained. Entire layout planned by the Electricity Sales Department, Commonwealth Edison Company, Chicago, Illinois. (Contractor—Hultgren Electric Corporation, Chicago.)

Bankers, like all other progressive businessmen, know that really good lighting is a shrewd investment on two counts. First, it pays for itself in greater employee comfort and efficiency. Second, it builds better business because it promotes better public relations.

Naturally, MITCHELL Fluorescent Lighting is preferred by public-service institutions, because MITCHELL has established a superior reputation for lighting service in the institutional field. MITCHELL Lighting imparts dignity and prestige to the finest interiors, combining impressive appearance with effective high-level, evenly distributed, comfortable illumination.

For greater employee efficiency, for better public relations and more profitable business, MITCHELL Lighting is a gilt-edge investment.

The Peoples Bank installation is typical of hundreds which are building acceptance for MITCHELL Lighting—and bringing better business to the wholesaler. MITCHELL sales are clean package transactions—trouble-free volume business. MITCHELL installations are easy, smooth jobs for the contractor—time-saving, profitable business.

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Far West: *Complete Modern Plant and Sales Office at Los Angeles Serves the Entire Pacific Coast Area*
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Makers of Commercial and Industrial Fluorescent Lighting Equipment Store Window Lighting • Spotlights and Floodlights • Desk Lamps • Portable Floor and Table Lamps • Bed Lamps • Ultraviolet and Infrared Health Lamps • Residential Lighting Specialties . . . Rad-I-Air Germicidal Units (made by Tru-Air Ultraviolet Products Co., Los Angeles)

1

VISUALIZE—Use G-E Lamp portfolios, visualizers, booklets, film slides, movies to kindle the interest of your prospects in better lighting.

2

SPECIFY—Special G-E Lamp calculators, intensity guides, manuals and layout guides are available to help you specify the right lamps and fixtures for any job.

3

SELL—Train your organization with General Electric's LaSalle course on lighting sales. Use G-E direct mail, lamp data, selling plans.

4

INSTALL—Whatever lamps you need, G-E makes 'em all! And you can simplify the installation job by using G-E engineering bulletins, data sheets and test kits.

5

FINANCE—Planned Lighting jobs are easier to sell when you can offer your customers the financing convenience of the General Electric Credit Corp.

6

MAINTAIN—The program includes full information on lighting maintenance as a profitable business—plus the actual forms and promotional material you'll need to get started.

Your face will light up too!

... when you see G-E's program to help you sell more Planned Lighting

TODAY'S lively store lighting market offers a rare profit opportunity to the contractor who knows how to lay out and sell the modern Planned Lighting installations store owners want. That's where we can help you! General Electric has a timely 6-point program designed specifically to equip you with all the information and actual materials you need to go after this valuable business. It's practical! It's complete! Read what General Electric offers under each of these six points—and see if your face doesn't light up too!

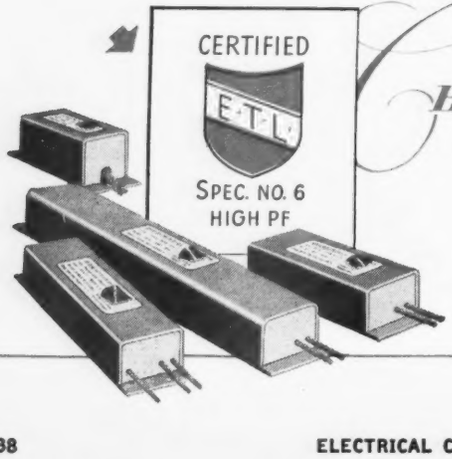
G·E LAMPS

GENERAL ELECTRIC

COLLECT There's plenty of proof that this 6-point plan pays off! If you want to brighten your profit picture, call your G-E Lamp district office today and get the details. General Electric Company, Lamp Department, Nela Park, Cleveland 12, Ohio.

"... and the thing you <u>don't</u> see makes the big difference in fluorescent lighting!"

We're talking about auxiliary equipment . . . the BALLASTS that are responsible for satisfactory performance and dependable operation of fluorescent lamps and fixtures. Ballasts are the *heart* of the fixture—and using the *right* ballasts makes a whale of a difference! The answer is simple: CERTIFIED BALLASTS, built to rigid specifications, tested, checked . . . and CERTIFIED by famous Electrical Testing Laboratories, Inc., as to compliance with those specifications. That's why the familiar ETL Certified Label on ballasts is all-important.



CERTIFIED BALLAST MANUFACTURERS

Makers of Certified Ballasts for Fluorescent Lighting Fixtures

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Bellwood, Illinois

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Starring and Company
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Wheeler Insulated Wire Co., 378 Washington Ave., Bridgeport, Conn.

In the News

Chicago Host to Illinois Inspectors

More than 130 electrical inspectors braved sleet and wintery blasts to participate in the 17th Annual Meeting of the Illinois Chapter, IAEI at Chicago's Hotel Sherman on Jan. 30-31. On the agenda of the two-day session were technical subjects, the new 1947 Code and a half day devoted to inspector problems.

After welcoming the delegates to the city, Paul Gerhardt, Jr., Commissioner of Buildings, City of Chicago, commended the inspectors on the progress made in promoting electrical safety. Acknowledging the importance of their work, he urged the establishment of electrical commissions or boards in every city and municipality to assure safe electrical installations and the application of diplomacy in the dispatch of inspector duties. Asserting the need to keep abreast of developments, he revealed that both the Chicago building and electrical codes are now in the process of revision.

Understanding the principles of grounding is easy if you just remember that the best way to avoid a difference of potential between two metallic objects is to simply tie them together, stated O. K. Coleman, engineering consultant of Lafayette, Indiana. Elaborating with a blackboard discussion, he reviewed urban and rural grounding technique reiterating that the safest method is to tie all grounding systems together. Best assurance of safety on portable tools is to have an insulating jacket (plastic or otherwise) over the metal case, he added, stating that there is never any assurance that the ground conductor in a portable cable is always intact.

The rigid specifications and accelerated tests that cables and wires must meet to fulfill Underwriters requirements as to moisture, heat, and corrosion properties were outlined by E. N. Davis, rubber research chemist of Underwriters Laboratories, Inc., Chicago.

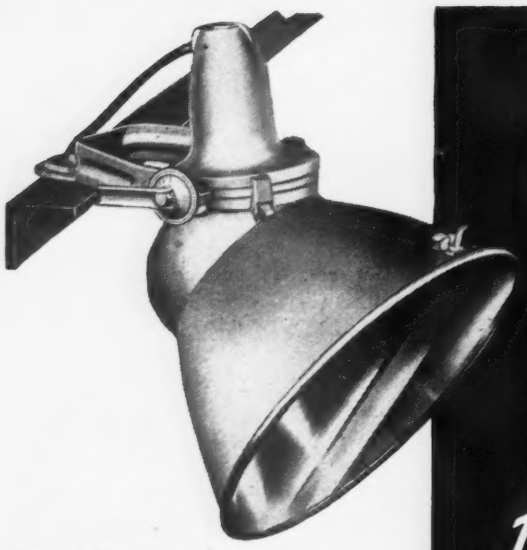
Salient changes in the new 1947 National Electrical Code were outlined by Victor H. Tousley, Chicago, electrical field engineer of the National Fire Protection Association. He expressed the hope that copies of the new Code will soon be in the hands of every inspector.

Carl E. Grover, application engineer, Bussman Manufacturing Company, reviewed the application of Fusetrons to motor circuits, reminding the inspectors that these units meet Code requirements for motor protective devices and present a definite economic advantage.

A general picture of the vast distribution system serving the Chicago area was presented by L. J. Hau, senior engineer, Commonwealth Edison Company, during his general discussion of the 12 kv. Network system. Closing the first session, D. J. Talbot, chief electrical inspector, City of Chicago, presented an interesting discussion of wiring methods.

Following a half-day session on individual inspector problems, led by Roy Burgess, assistant chief electrical inspector, City of Chicago, Don B. Karlskind, U. S. Rubber Company presented the story of the newly developed aluminum building wire. Although this material was originally introduced as an emergency measure to alleviate the copper shortage, Mr. Karlskind firmly believes it is here to stay. Supporting his contention, he cited numerous instances where recent installations have received favorable comment both from engineering and contractor sources. In some cases aluminum wire is being substituted for copper conductors which require frequent replacement due to corrosive atmosphere, he revealed. Operating and installation data are now being compiled. The physical properties of the new wire may well overcome the electrical conductivity handicap.

"Paw says you want too much to wire the whole house. Just put in one of them short circuits he's heard so much about."



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★ Proper types and sizes for all applications

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FLOODLIGHT	PUBLICATION
Heavy-duty, steel casing	
200 or 250 watts, Type L-29	GEA-4303
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750 or 1000 watts, Type L-31	GEA-4305
Heavy-duty, cast aluminum	
1000/1500 watts, Type L-34	GEA-4517
200 or 250 watts, Type L-38	GEA-4325
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300 or 500 watts, Type L-49	GEA-4311
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Sports and area, sheet aluminum	
750 to 1500 watts, Type L-68	GEA-4333
750 to 1500 watts, Type L-69	GEA-4590
Area, open porcelain enamel	
300 to 1500 watts Type L-45	GEA-4433
300 to 1500 watts Type L-46	GEA-4434
Handy, sheet aluminum	
100/150 watts, Type L-65	GEA-4516
200 watts, Type L-66	GEA-4346
Underwater, cast bronze	
100/250/400 watts, Type L-33	GEA-4438
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500/1000/1500 watts, Type L-41	GEA-4439

Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

Western Section president A. H. Welklin, Ft. Wayne, Ind., announced that the Board of Directors recently decided to hold the 1947 Western Section Convention in Montreal, Canada.

Illinois Chapter officers elected for the ensuing year include: Chairman—H. C. Frieden, Moline; first vice-chairman—F. K. Hanlin, Chicago; second vice-chairman—J. T. Swanson, Rockford; third vice-chairman—J. R. Moore, Chicago; secretary-treasurer—W. J. Alcock, Chicago. P. J. Markey, Chicago, remains chairman of the Executive Committee. Industry representatives on this committee include: Contractors—J. Walter Collins, secretary, Electrical Contractors Association of City of Chicago; wholesalers—Arthur Anixter, Englewood Electric Supply Co., Chicago; manufacturers—A. A. Sommer, Chicago district manager, Bussman Manufacturing Company.

The Mid-year meeting of the Illinois Chapter was tentatively set for June 5-6 at Moline, Illinois.

Seattle Contractors

The Electrical Contractors of Washington has been formed at Seattle by representatives of 60 electrical companies to formulate a code of ethics and fair practices for the industry. J. H. Hooper was elected temporary president, with T. R. Neilson first vice-president, Carl E. Fellstrom second vice-president, Fred A. Engel secretary and J. E. Atkinson treasurer.

Contractors in South Dakota Organize

Plans for a permanent state electrical contractors organization in South Dakota were formulated when 45 of the state's leading contractors recently met at Huron, S. D. Until final approval of by-laws, the following will act in the capacity of temporary officers: Chairman—Ivan Mathes, Aberdeen; secretary—E. M. Lothrop, Huron; treasurer—Wayne True, Watertown.

Comprising the organization committee—in addition to the above officers—are: Al Baumgartner, Rapid City; M. H. Meisl, Tyndell; Max Nickel, Sioux Falls; G. E. Humphrey, Mitchell; Orley Thompson, Veblen; Allen Harmes, Mitchell; and Howard Peterson, Webster.

High on the agenda of the newly

QUICK RELIEF for the BUILDING WIRE SHORTAGE

approved by N. E. C.

..here are some of the facts:

- Worldwide shortage of copper shows strong evidence of continuing through '47, maybe longer, thus prolonging present difficulties on deliveries of the heavier sizes of conductors.
- Because of its high conductivity and excellent record for durability, aluminum is the natural substitute.
- Current carrying capacity of aluminum Performite Building Wire, Type RH, equals that of copper Hazacode, Type R. The 16% difference in conductivity between copper and aluminum is compensated for by the temperature rating spread between the two types of insulation.
- Therefore no increase in conductor or conduit size is required except where runs are so long as to involve excessive voltage drop, or where substituting Type RH aluminum for Type RH copper.
- Aluminum Type RH Wire costs no more than copper Type R because the higher cost of the better grade Performite Type RH rubber is offset by the lower cost per 1000 feet of aluminum.
- The lighter weight of aluminum insulated conductors provides handling, transportation and installation advantages.
- Quick relief for the building wire shortage is now provided on sizes No. 6 Awg and larger Hazard Aluminum Performite Building Wire Type RH, where approved by local inspection authorities.

TO GET ALL THE FACTS, write for technical Bulletin H-407, illustrated above, which gives tables of capacities, comparative weights, data on characteristics; information for quick determination of voltage drop, conductor sizes, circuit length and currents for both aluminum and copper. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

HAZARD

insulated wires and cables for every electrical use

SIMPLEX adds Neoprene Jackets to Anhydrex Underground CABLES

A NEW JACKET of tough neoprene now protects all ANHYDREX Underground Cables. Its many outstanding features, combined with those of the Anhydrex insulation, make these improved cables ideal for service in both underground and open-air circuits.

SIMPLEX ANHYDREX INSULATION

Has excellent electrical properties; High dielectric strength, low power factor, low specific inductive capacity.

Effectively resists moisture. It has greater moisture-resistance than any other rubber insulation on the market today.

Has excellent aging qualities.

SIMPLEX NEOPRENE JACKET

Cannot rust or rot.
Requires no duct lubricants.
Will not "freeze" to ducts.
Resists soil acids and oils.
Is not subject to electrolysis.
Is flame and abrasion resistant.
Is immune to sun-checks and cracks.
Is more flexible than metallic sheaths.

Recommended for series street lighting, service entrance, and power transmission. Easy to tap, joint, and terminate.

May be installed with or without ducts.

Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

2. Putting finishing touches on program for the 1947 NISA Convention are (L to R) Ed Burke, Charles J. Cannon and president Robert Turner at recent Detroit meeting. Convention will be held in Detroit, March 31 through April 3.

formed group is the acquisition of a state electrical licensing law modelled after the existing Minnesota and North Dakota Laws. Based on conferences with various industry members, state officials and legislators, the new group is confident of widespread support in this venture.

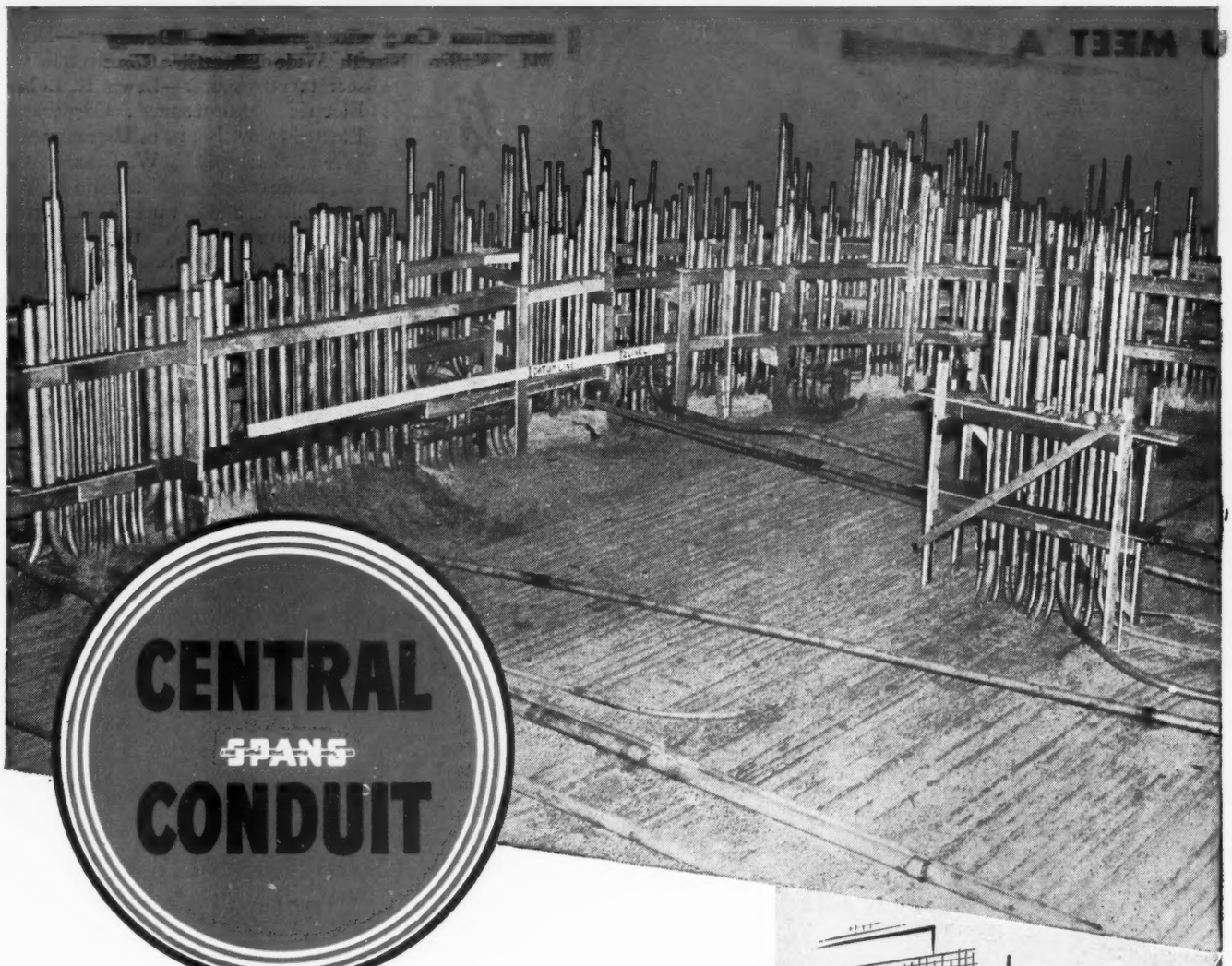
Sentiment of members of the South Dakota group indicates a desire to affiliate with the Minnesota Electrical Council at some future date. Last year the North Dakota Electrical Contractors Association approved such affiliation of their group.

Twin-Cities Groups Elect New Officers

Annual meetings of the St. Paul and Minneapolis electrical contractor organizations featured installation of newly elected officers to serve during 1947. Chosen to pilot the activities of the specific groups were the following:

St. Paul Electrical Contractors Association — President —Arthur W. Swanson, A. W. Swanson Company; vice-president — D. A. Rosecrans, Rosecrans Electric Co.; secretary-treasurer — L. J. Tieso, East Side Electric Company. The Board of Directors include: Harry Frye, August E. Hansen, Ed Hoffman, John Kostka, Ben Padwal, Paul Schorr, Sr., and Vern Wright. Representing the St. Paul group on the Minnesota Electrical Council Board of Directors are A. W. Swanson, Lawrence Rylander and William Lindberg.

Minneapolis Electrical Contractors Association—President—Arthur Ingebredtson, Electric Repair & Con-



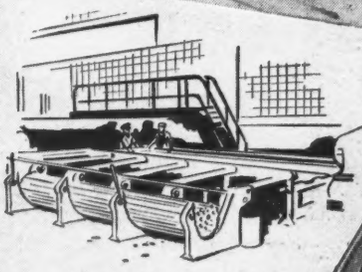
CENTRAL SPANG CONDUIT

RESISTS MECHANICAL INJURY

Ruined material delays jobs and robs you of profit. Central Rigid Steel Conduit, made from full, standard weight Spang CW or Lapweld Pipe, has strong walls which can't be injured by nails, wheelbarrows, etc. Stubs won't be broken off during construction. That's why it's important to use Central Rigid Steel Conduit.

Central Rigid Steel Conduit will resist corrosion caused by water, weather or chemicals. Connected by threaded couplings, it can withstand vibration which might disturb lighter conduit after installation. And Central Rigid Steel Conduit meets all the National Electrical Code requirements for moisture, vapor and dust proof requirements in hazardous locations and occupancies.

There is a tremendous demand for both galvanized and black enameled Central Rigid Steel Conduit. Consequently, your distributors may not be able to supply you as quickly as he would like. But keep in touch with him. He will make sure you get your share of the available supply.



"There's Tested Strength in Every Length"

Every length of Central Rigid Steel Conduit carries the Underwriters' Laboratories seal of approval.

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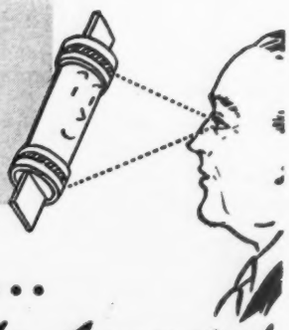
WHEN YOU MEET A

Monarch Fuse

FACE TO FACE....



You are Impressed with the Amount of

BRASS

INSIDE AS WELL AS...

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Monarch *Renewable* Fuses

are famous for

BETTER HEAT DISSIPATION

and

EXTRA LONG SERVICE

AVAILABLE THROUGH RECOGNIZED WHOLESALERS

MONARCH FUSE CO., LTD.

118 E. FIRST ST. JAMESTOWN, N. Y.

struction Co.; vice-president—Dewey M. Wallin, North Side Electric Co.; secretary-treasurer—Lewis E. LeMay, Electric Maintenance Corporation. Elected to the Board of Directors were W. A. Starbird, C. W. Cramer, Carl E. Lindgren, Oscar Batzli, William S. Collins, and Frank T. Langford. Representatives on the Minnesota Electrical Council Board of Directors are Arthur Ingebredtson, F. M. Tripp, and John Kvalsten.

Macon Contractors Organize

Electrical contractors in Macon, Ga., have organized the Macon Electrical Contractors Association with J. H. Starr, of Brown-Starr Electric Co., as president. Other officers include J. T. Price, of Bibb Electric Co., as vice-president and Gordon Bray, of Bray Electric Co., as secretary-treasurer.

Rochester Chapter Elects Officers

Alvin Mueller of the Dwyer Electric Co., Inc., was elected president of the Rochester Chapter of the National Electrical Contractors Association, Earl Driscoll vice president, and Bert Davison treasurer.

E. A. Vanderlinde of Vanderlinde Electric Company was reelected a member of the NECA Board of Governors and E. J. Kramer was reelected secretary.

Electrical Home Planning

"Planning the Kitchen Electrically" is the first of a series of manuals designed to provide architects and builders with practical data on construction details and space requirements for electrical equipment in the kitchen. The manual is prepared by A. Carl Bredahl, manager of the Westinghouse Better Homes Department. Additional compilations are scheduled to discuss electrical requirements in other rooms. In this booklet, Mr. Bredahl divides homes into four classifications, depending upon size of home and degree of electrification.

this cable won't quit when jobs are HOT!

Wiring in high-temperature locations is vital to steady plant operation. If a power cable quits, if a control circuit fails, it may ruin a "heat" or close down a department.

For years, plant engineers with hot jobs to wire have specified Deltabeston* power cable and boiler-room wire. They recognize the practical application experience which General Electric has been able to put behind them. They know that new research is always under way.

In many cases, too, it's the selection of the right *type* of heat-resistant cable that's so important to long life. The Deltabeston line includes standards and "specials" for every combination of heat, moisture, corrosive vapor or other condition. And *men who know the problem* stand back of your Deltabeston supply source, ready to advise you or your contractor on selection. For full information on Deltabeston cables or wires for *any* hot job, write Section Y53-318, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

**Trade-mark Reg. U. S. Pat. Off.*

GENERAL ELECTRIC

HI-AMBIENTS

Practical product suggestions from your Deltabeston Distributor

FOR FLEXIBLE LEADS . . . on heavy apparatus that involves hot work, such as electric furnaces, cranes handling hot metals, and the like, Deltabeston YK-2253 is a popular choice. Insulated with an impregnated wall of felted asbestos and asbestos braid, it resists heat, flame, oil and corrosive vapors up to 125 C (257 F).

IF YOU ARE PUZZLED . . . as to the relative merits of asbestos-insulated versus glass-insulated magnet wire for any particular application, you can get unbiased advice from Deltabeston application specialists. The Deltabeston line includes both. And for extra severe jobs, glass-insulated wire with *silicone varnish* is now becoming available. Its rating is 200 C.

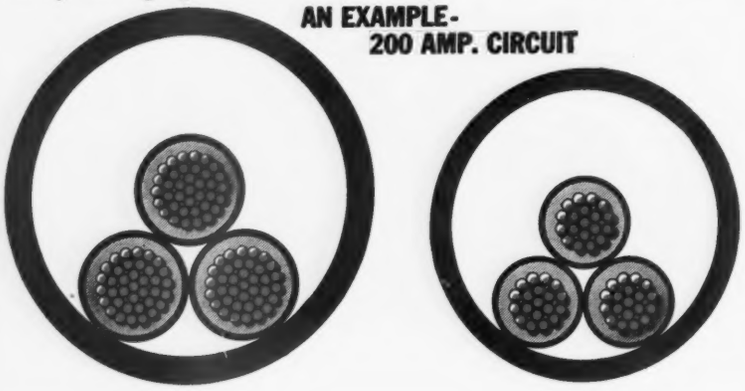
FLUORESCENT FIXTURES . . . need heat-resistant wiring in and around the ballast. For those located in hot, humid places, *all* the wiring should be heat resistant. Why not make your installation with the same type of Deltabeston wire which ballast and fixture manufacturers use?

WIRING JET PLANES . . . may be a long way from your business, but the choice of a Deltabeston Aircraft Wire for this extra-severe duty helps explain why so many folks turn to us for solutions to "impossible" insulation requirements.

DELTABESTON
Wires and Cables
Built to beat the heat

CRESCENT
ENDURITE
Type RH
Gives Greater Current Carrying Capacity per Dollar of Installed Cost

AN EXAMPLE-
200 AMP. CIRCUIT



250,000 CM

3/0

TYPE R

Requires 2½" Conduit. Maximum permissible operating temperature 60° C.

For 100 ft. run cost for wire and conduit—approximately

$159.00

TYPE RH

Requires 2" Conduit. Maximum permissible operating temperature 75° C.

For 100 ft. run cost for wire and conduit—approximately

$116.00

Both figures are based on 330 feet of cable and 100 feet of galvanized steel conduit at PRESENT LIST PRICES. Saving shown—27%. The superior heat resistant characteristics of CRESCENT ENDURITE INSULATION with its higher permissible operating temperature and therefore greater current carrying capacity, permits the use of a smaller size of conductor, and in most cases smaller size of conduit at less cost than would be required for Type R Wire for the same load.

For light loads requiring small sized conductors, Voltage Drop is the determining factor in choice of wire size. Usually in sizes No. 6 AWG and heavier for power circuits or No. 1 AWG and heavier for lighting circuits, CRESCENT ENDURITE Type RH Wire & Cable gives the lowest installed cost-per-ampere of useful circuit capacity.

CRESCENT
WIRE and CABLE

NEMA

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, NEW JERSEY

Fundamentals of kitchen planning and basic kitchen plans are discussed in detail, using standards ranging from bare necessity to peak convenience. These four classifications or standards are referred to as thrift, budget, ideal and deluxe. Sixteen layouts are suggested for use, including variations of U and L-shaped arrangements. Layouts increase in size to include requirements of homes having from one to five bedrooms. Detailed layouts follow the key plans, listing equipment required, establishing storage and counter surface facilities, suggesting various types of lighting, giving arrangements and capacities of outlets, locating switches and ventilation fans, specifying protective devices and recording load requirements as an aid in adequately wiring this work center.

Two-color printing, 74-pages sized 8½ by 11 inches. Price, one dollar. Better Homes Department, Westinghouse Electric Corporation, Pittsburgh 30, Pa.

DATES AHEAD

Chicago Production Conference — Sponsored by Chicago Technical Societies, Hotel Stevens, Chicago, Ill., March 17-19.

North Central Electrical Industries—All-Industry Convention, Hotel Duluth, Duluth, Minn., March 17-19.

National Industrial Service Association—Annual Convention, Hotel Statler, Detroit, Mich., March 31, April 1-2.

Midwest Power Conference — Palmer House, Chicago, Ill., March 31, April 1-2.

National Association of Corrosion Engineers — Annual Convention, Palmer House, Chicago, Ill., April 7-10.

Home Builders Council of N. Y., N. J. and Connecticut—A Metropolitan Home Show, Grand Central Palace, New York, N. Y., April 19-27.

Chamber of Commerce — Washington, D. C., April 28-May 1.

National Electrical Wholesalers Association—Annual Meeting, Hotel Traymore, Atlantic City, N. J.; May 4-8.

National Plastic Exposition — Coliseum, Chicago, Ill., May 6-10.

Illuminating Engineering Society — East Central Regional Conference, Washington, D. C., May 22-23.

National Fire Protection Association—51st annual meeting, Palmer House, Chicago, Ill., May 26-29.

American Institute of Electrical Engineers—Summer meeting, Montreal, Quebec, Canada, June 9-13.

National Electrical Manufacturers Association—Special section meetings, The Homestead, Hot Springs, Va., June 22-26.

Illuminating Engineering Society—Annual convention, New Orleans, La., September 5-10.

National Electrical Contractors Association—Annual meeting, San Francisco, Calif., September 8-10.

International Municipal Signal Association, Inc.—Annual meeting, Pantlind Hotel, Grand Rapids, Mich., September 29-October 2.

National Safety Congress & Exposition—Chicago, Ill., October 6-10.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., Week of October 27.

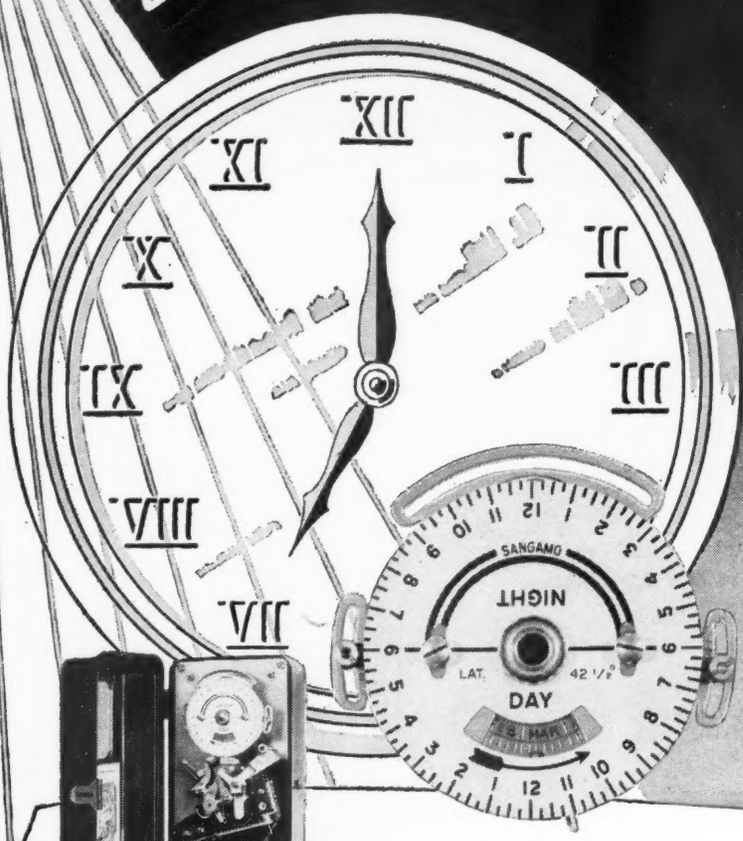
American Institute of Electrical Engineers—Midwest meeting, Chicago, Ill., November 3-7.

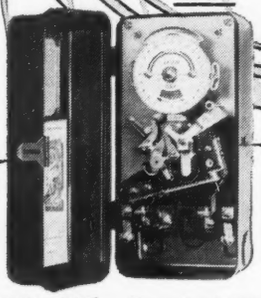
2nd International Lighting Exposition—Hotel Stevens, Chicago, Ill., November 3-7.

National Metal Trades Association — Palmer House, Chicago, Ill., November 6-17.

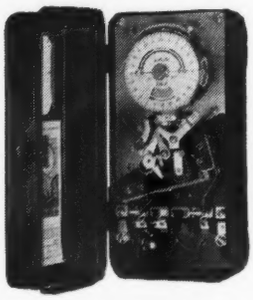
National Association of Manufacturers—Waldorf-Astoria Hotel, New York, N. Y., December 3-5.

Just what time is it at dusk and dawn





TYPE KAZ. Astronomic-Dial Equipped, this type is available in wide variety of combinations, described in Bulletin No. 98.



TYPE VSWZ, In addition to its Astronomic Dial, this switch is equipped with the automatic "carryover", providing continuous operation during current interruptions.

Wherever your lighting installation may be, Sangamo Astronomic Dial Time-Switches operate automatically at "Dusk" and "Dawn", adjusting to the daily changes in length of daylight. This fully automatic operation eliminates periodic re-setting of the dial required with conventional switches. For fully automatic control of "Dusk" and "Dawn" lighting installations, specify Sangamo Astronomic Dial Time-Switches. Although production of Sangamo Time-Switches is now at a much higher than pre-war rate, a large backlog of orders suggests early placement of your order for future delivery.

Write now for Bulletin No. 98 which contains complete information on the wide variety of control features available in Sangamo Time-Switches.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Installed wherever Profits Count

plenty of jobs in every shop or plant for

R & S EXPLOSION-PROOF FIXTURES AND FITTINGS FOR ALL OUTDOOR AND HAZARDOUS AREAS

There are satisfactory profits when installing R & S Electrical Fittings and Fixtures for those hazardous and outdoor jobs. Profits on the many units and wiring installations . . . and profits, likewise, in customer good will. And you keep the profits you make because R & S products withstand the toughest service conditions . . . whether meeting the abuse of extreme climatic conditions, vapors, dust, or explosive gases. Once installed there is no costly trouble-shooting. The reason why: R & S Fixtures and Fittings are precision-built, sturdily constructed, and undergo severe tests to assure enduring and dependable performance.

4201 BC

4462

4507

4201 BCC

4411

4521

The well-known R & S EVER-LOK wiring devices prevent accidental interruption of service for the life of the job. All units afford a high degree of interchangeability.

A descriptive and illustrated broadside No. 101-4 gives pertinent information. Write for your copy.

SALES OFFICES IN PRINCIPAL CITIES

SINCE 1902

RUSSELL & STOLL COMPANY, INC.

Precision-Built Electrical Equipment

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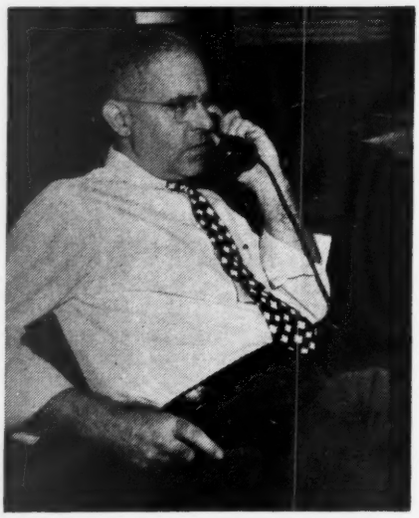


Fred Somes, chief estimator-engineer of the Hydon-Brand Company—prominent Detroit electrical contractors—solves a field engineering problem via telephone.

MANUFACTURERS NEWS

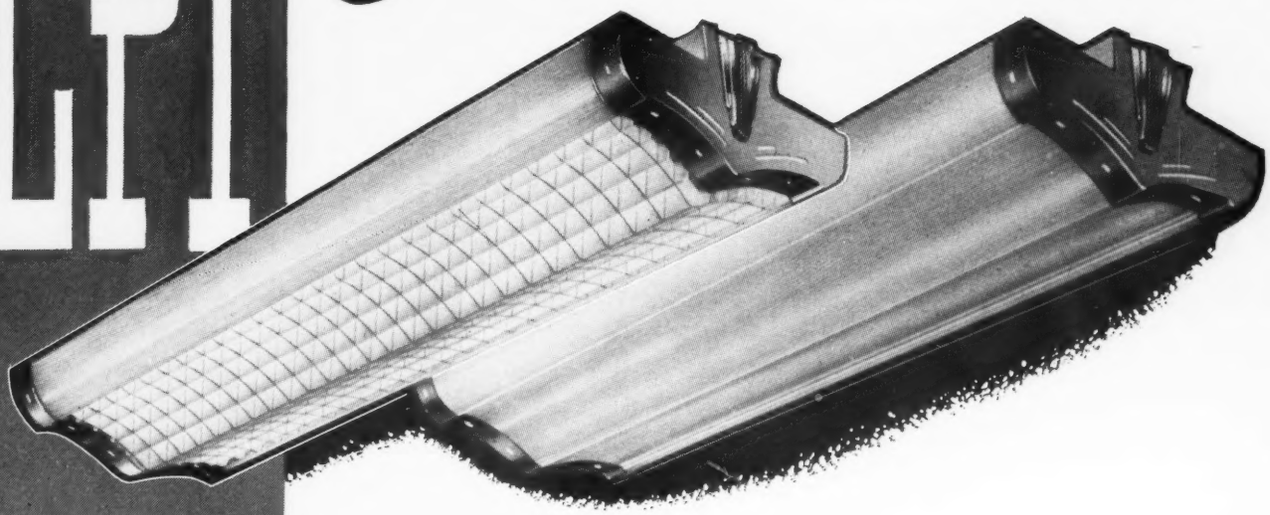
APPLETON ELECTRIC CO. ELECTS NEW OFFICERS

Directors of the Appleton Electric Company of Chicago announce the election of Arthur I. Appleton, formerly executive vice president, as

ALBERT I. APPLETON

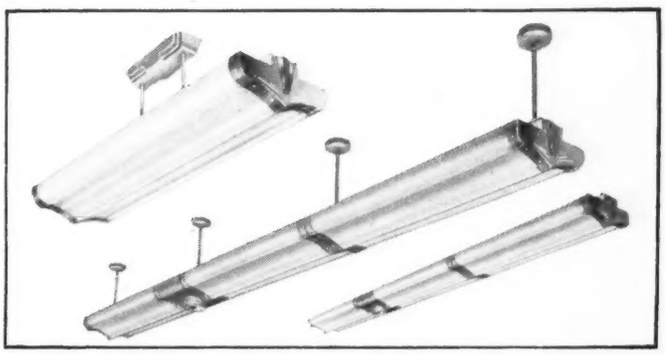
ARTHUR I. APPLETON

LPI Constellation



EASY INSTALLATION

The Constellation keynotes facility. Housing is equipped with all necessary slots, holes, and knockouts, so that it may be surface or pendent mounted in single units or continuous runs . . . Installations can be made quickly and easily by following the clear, simple directions included in every shipment.



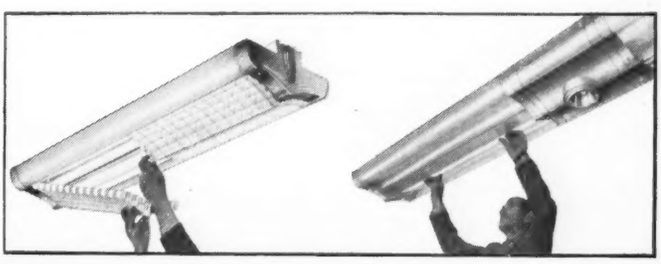
(Above) Pendent or surface mounted, in single units or continuous runs, the Constellation can be installed quickly and easily, affording both beauty and lighting efficiency.

EASY MAINTENANCE

The new LPI Constellation virtually eliminates maintenance problems. Every Constellation, regardless of the type of installation, can be relamped from the top of the unit without disturbing any part of the fixture. Hinged louvres and sliding glass panels offer even greater ease of maintenance.

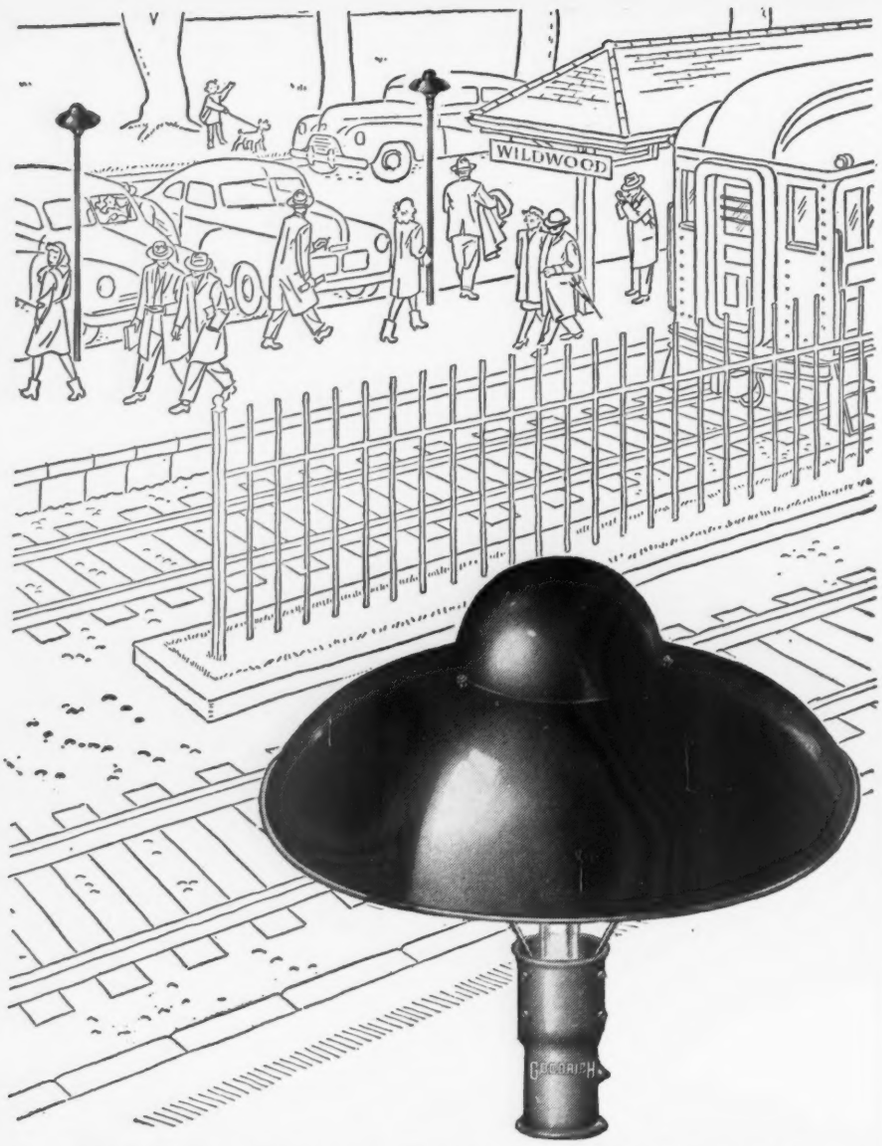
Request the new LPI Bulletin No. 400 for more detailed information on the Best That's New in Lighting.

LPI products are sold exclusively by leading electrical distributors. (Design patents pending)



(Above) No louvres to remove—No glass to take out. Simply open the hinged louvres or slide back the glass panels. Lamps, starters and wireway are immediately within easy reach.

LIGHTING PRODUCTS, INC.
HIGHLAND PARK, ILLINOIS

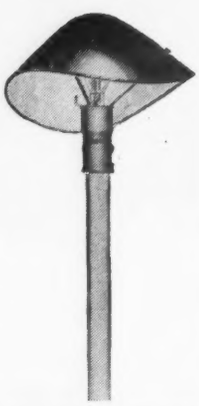


BETTER LIGHT FOR BUSY PLACES

the Goodrich Standlite—Railroads find the Standlite ideal for use on station platforms, bridges, footwalks, around switching zones, sidings, etc. And hundreds of industrial users find that it answers their needs—exactly.

There are good reasons for the popularity of the Goodrich Standlite. It is porcelain enameled, entirely weatherproof. It combines high efficiency with modern, distinctive appearance. It brings light closer to the ground, diffuses it over a wide area, minimizes glare. Low mounting height makes for easy installation, easier servicing. And it's built to last!

If modern high intensity illumination can add to safety or service in your busy locations, get the facts about the Goodrich Standlite.



The Elipso Angle Standlite directs light forward and laterally in a long, narrow pattern.

RLM

Sold Through Electrical Wholesalers

GOODRICH
ELECTRIC COMPANY
4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

president and treasurer to succeed his father, Albert I. Appleton, who will assume chairmanship of the Board of Directors.

Albert I. Appleton founded the company in 1903 and has directed its growth since then. Arthur I. Appleton's service with company dates from 1936, and was interrupted only by a two-year tour of duty as a naval officer during the war.

John A. Appleton, also a son of the founder, was elected vice president. Murray J. Whitfield has been re-elected vice president in charge of sales, and H. M. Schlobaum, was elected secretary.

G-E APPOINTMENTS

The Lamp Department of General Electric Company has established a new Ohio Valley Sales District, with headquarters in Cincinnati. W. E. Davidson, a member of G-E Lamp Department for ten years, has been named manager of the newly created district. The Ohio Valley Sales District covers the southern portion of Ohio, most of Kentucky, and a few counties in Southern Indiana. This area until recently had been served by the Buckeye Sales District, headquarters for which remain in Cleveland.

Robert P. Allison, Jr. and Howard J. Stewart have been appointed manager and assistant manager respectively of the General Electric Company's new Marginal Street Works in Lowell, Mass.

GEORGE BUTLER STAFF ADDITIONS

Recently announced additions to the staff of the George Butler Company, Chicago, Ill., include W. C. Foss and W. I. Morrison .

Mr. Foss, with the Westinghouse organization for over 20 years, was district purchasing agent when he resigned to join Butler.

Mr. Morrison, representative of the Economy Fuse Company in the Iowa territory for more than twenty years, brings a wide acquaintanceship with the Central States electrical jobbing trade to the rapidly expanding Butler firm.

SYLVANIA APPOINTMENTS

Leo E. Duval, Jr. has joined the commercial engineering staff of the Lighting Products Division of Sylvania Electric Products, Inc.

W. H. Childs, Jr. and G. H. Mackenzie have joined the sales department of the Lighting Products Division to become members of the sales service organization.

LOADS ARE HEAVIER TODAY . . . BUT

PORCELAIN

PROVIDES EVERY REQUIREMENT FOR AN ADEQUATE SYSTEM

• There has been continuous improvement in the manufacture of Porcelain Protected Wiring Systems during the past 50 years. Manufacturers, through experience, research, and advanced production methods, have kept pace with the times. These systems have, therefore, always been available and adequate as America made such great modernization strides as the past half century rolled by.

Today the quality of modern PORCELAIN used in these protective wiring systems amply provides for heavy loads with a wide factor of safety. This safety was a feature of porcelain when it served the lighter loads of yesteryear.

For the home building program that is at hand and which promises to increase in scope, consider carefully the following . . .

Quick PORCELAIN PROTECTED WIRING SYSTEM installations are accomplished—economical results are realized — complete insulation and protection from the entrance switch to the very last outlet on the system—short-proof and shock-proof qualities of porcelain contribute to dependability — rust- and corrosion-resistance characteristics make porcelain the ideal material in damp, wet, or dry locations — meets future load increase — allows for easily made alterations and additions.

PORCELAIN PROTECTED WIRING SYSTEMS

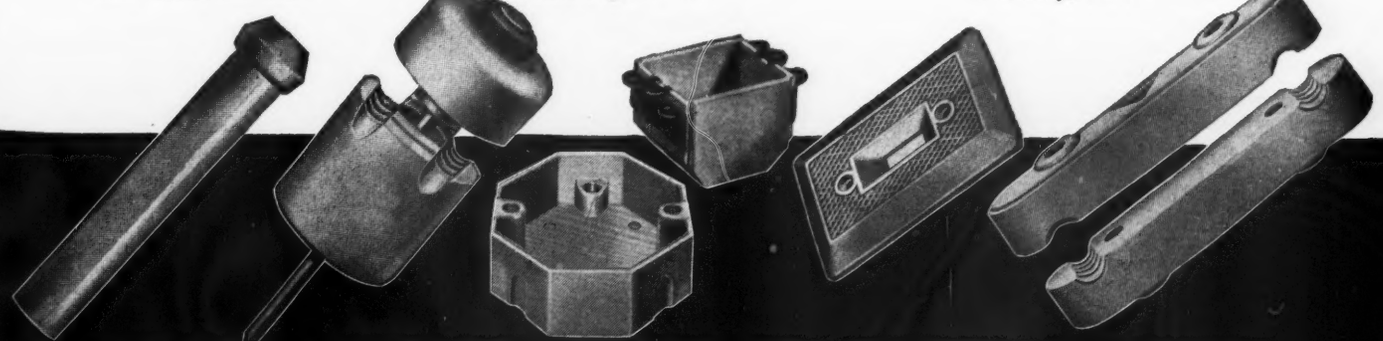
★ **ILLINOIS ELECTRIC PORCELAIN CO.**
Macomb, Ill.

★ **PORCELAIN PRODUCTS, INCORPORATED**
Findlay, Ohio

★ **SPECIALTY PORCELAIN WORKS**
East Liverpool, Ohio

★ **SUPERIOR PORCELAIN COMPANY**
Parkersburg, W. Va.

★ **UNIVERSAL CLAY PRODUCTS COMPANY**
Sandusky, Ohio



MODERN PORCELAIN PROTECTED WIRING SYSTEMS

SOLDERLESS—TAPELESS

Wire Connectors

SOLAR

SCRU-ITS

"MR. SCRU-IT" Trade Mark

Solar SCRU-ITS are used for connecting two or more wires without tape, solder, flame or tools. They are economical and easy to use—wire ends are stripped and SCRU-ITS screw right on to form a compact and efficient joint.

SCRU-ITS give better mechanical and electrical contact . . . eliminate possibilities of shorts, grounding and corrosion. Their compact size permits their use where working space is at a minimum.

Available in several sizes for connecting various combinations of wires.

EASY TO USE:

1. STRIP WIRE

2. SCREW IT

3. THAT'S IT with SCRU-ITS!

DON'T TAPE
DON'T SOLDER
"SCRU-IT"!

- MADE IN FOUR SIZES
- MAY BE USED WITH SOLID OR STRANDED WIRES

MILLIONS IN USE • HUNDREDS OF APPLICATIONS

"Roughing-in" or permanent wiring is simplified with SCRU-ITS . . . they thread on with a twist of the wrist . . . and the joint is complete!

- Fixtures
- Outlet Boxes
- Fuse Boxes
- Panel Boards
- Switch Boxes
- Lighting Devices
- Conduit Boxes
- Circuit Breakers
- Switch Controls
- Motor Connections

and many others.

U S PATENT NO 1,933,555

Write for Data Sheet U-3.

For complete specifications on SCRU-IT sizes, uses, prices, etc., WRITE TODAY.

SOLAR ELECTRIC CORPORATION

FACTORY and SALES OFFICES

WARREN, PENNSYLVANIA

WESTINGHOUSE CHANGES

A. Carl Bredahl has been appointed manager of the Better Homes Department of the Westinghouse Electric Corporation.

S. H. Harrison, formerly manager of machinery electrification for Westinghouse Pacific Coast District, has been appointed Pacific Coast manager of the corporation's Industrial Division. Mr. Harrison's headquarters will be in San Francisco.

M. F. Slusser, who for the past four years has been in the industrial sales department of Westinghouse, has been made manager of the construction and communications section of that department.

Appointment of N. C. Warner as manager of the Agency and Specialties Division, central district, has been announced. Mr. Warner will have offices in the Union Bank Building, Pittsburgh.

NOMA ELECTRIC APPOINTMENTS

Noma Electric Corporation, New York, has appointed four new vice presidents. They are Walter E. Fleischaker, Bernard E. Fleischaker, David Kahn and Joseph L. Kallus.

Allen W. Wexler has been named sales manager of the Pacific Coast District for Noma. Mr. Wexler's headquarters will be in Los Angeles.

LINCOLN ELECTRIC APPOINTMENTS

W. R. Persons has been named sales manager of the Lincoln Electric Company, Cleveland. Mr. Persons assumes his new position immediately, reporting to C. M. Taylor, recently advanced to executive vice president.

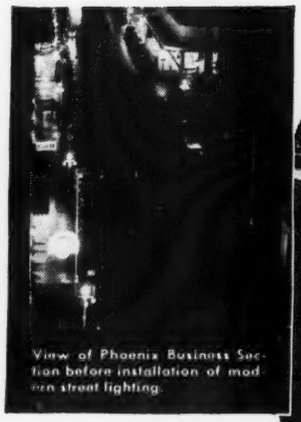
Lincoln Electric has announced new locations of its branch offices in San Francisco, Los Angeles and Birmingham. The San Francisco office and warehouse is now at 1302 Stanford Avenue, Emeryville 8, Calif. The Los Angeles office is at 1500 Calzona Street; and the Birmingham district office at 113 North Ninth St.

LYNN W. FERGUSON NAMED SALES MANAGER OF WHEELER

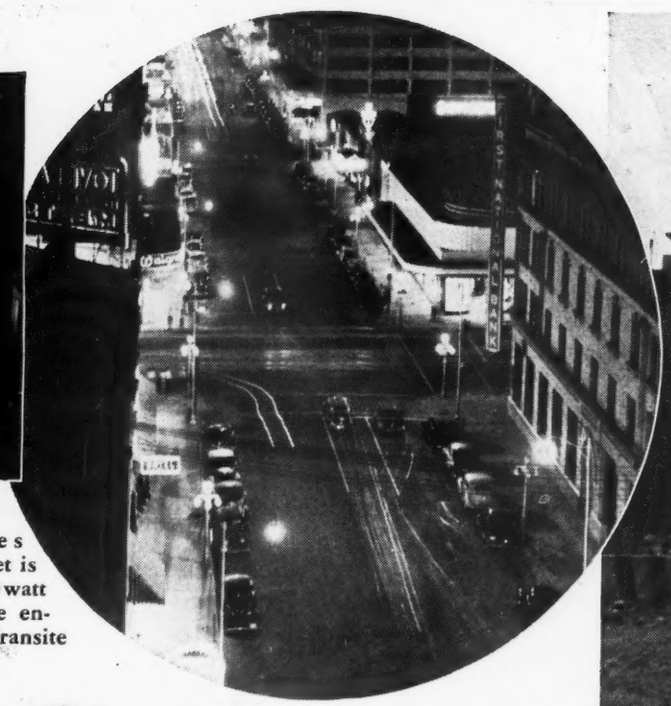
Lynn W. Ferguson has been appointed sales manager of the Wheeler Reflector Company, Boston, Mass.

Mr. Ferguson first became associated with Wheeler in 1930 as their Canadian representative, and in 1931 was appointed general manager of the newly formed Wheeler Reflector Company of Canada, Ltd.

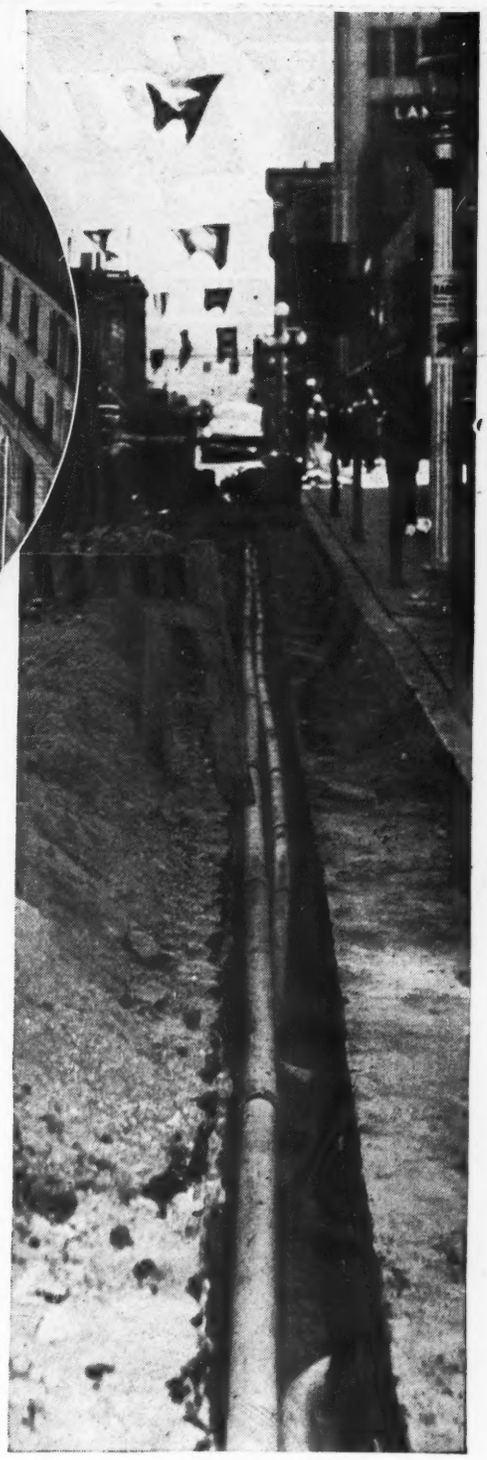
During the war he was active as a member of the Canadian War Production Board in Washington.



View of Phoenix Business Section before installation of modern street lighting.



Now 14 times brighter, the street is illuminated by 700 watt lamps. Cables are enclosed in J-M Transite Conduit.



Note that the long, lightweight lengths of J-M Transite Conduit are not concreted in, saving time and expense.

When Phoenix made this street brighter

Transite Conduit was used to do the job faster . . . at lower cost

J-M Transite Conduit cuts installation costs because it is lighter in weight—comes in longer lengths—has a smooth bore which makes long cable pulls easy. Also, a complete line of Transite Fittings speeds assembly. All this saves man-hours—results in fast, economical installations.

Yet Transite Conduit is also strong and longer lasting. Built of asbestos-cement, J-M Transite Conduit needs no concreting in to withstand the pressure and vibration of heavy traffic. It does not rot, rust or burn and cannot produce noxious, explosive gases . . . is immune to electrolysis and galvanic action.

Transite Conduit is a rapid heat transmitter, too . . . keeps cables cool, increases system capacity.

Learn all about these advantages by writing for Data Book DS 410, Johns-Manville, Box 290, New York 16, N.Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

TRANSITE DUCTS

CONDUIT for use without concrete

KORDUCT for concreting in

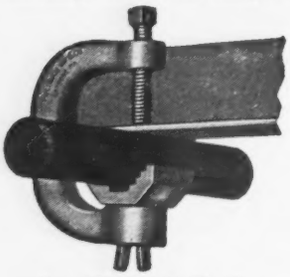
FULLMAN Latrobe PRODUCTS

FLOOR BOXES — WIRING SPECIALTIES

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE OB SUPREMACY LATROBE, PA.

"LATROBE" PRODUCTS SELL WELL BECAUSE THEY SERVE WELL

You are on safe, sure ground when you recommend "Latrobe" Products. They are easy to install, time-saving, labor saving—and long on performance.

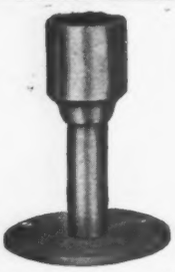


No. 470 "Bull Dog" Pipe or Conduit Hanger

Convenient and safe for hanging ½", ¾" and 1" pipe or conduit to steel beams up to ⅜" thick. Used also as ground clamp.

No. 110 Non-adjustable Watertight Floor Box

Body is made of strong iron with 3½" brass cover plate. Shown with No. 208 Receptacle and No. 207 Bell Nozzle.



No. 280 Nozzle with No. 200 Cover Plate

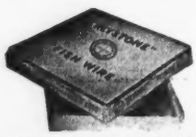
Ten Amp. 250 Volt Receptacle in Brass Housing mounted on ½" brass pipe extension. 8" long. Longer pipe if desired.

No. 252-R Two Gang Box

A popular two gang adjustable box with No. 208 Receptacle in one section. One cover plate with ½" Flush Brass Plug and the other with 2" Brass Plug.

"Bull Dog" Insulator Support

Used successfully for fastening porcelain or glass insulators to exposed steel work.



Keystone Fish Wire

Made of fine Flat Steel properly tempered. Ten sizes. Coils from 100 ft. up.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

NEW CORPORATION TO MANUFACTURE FLUORESCENTS

Electricraft Corporation, 42 Clifton Street, Newark, N. J. announces that it will shortly be in full production on a new line of fluorescent lights and fixtures.

Gerald J. Henry, formerly president of Wheeler Reflector Co. of Boston,

G. J. HENRY

will be president of the new company. Jack A. Lasser, formerly president of Mastercraft Electric of Newark, will be treasurer.

The products will be marketed under the tradename "Electricraft" and include fluorescents for most uses.

•

J. J. Mellon, who has been associated with the **Allen-Bradley Company,** Milwaukee, Wis., for the past two years, has been appointed chief engineer of that company. He will take over the activities formerly directed by Gustav O. Wilms, who recently went into semi-retirement.

•

Weston Electrical Instrument Corporation, Newark, N. J., announces the appointment of John H. Miller as vice president and chief engineer. He succeeds W. N. Goodwin, Jr., who, although retired, has been retained as an engineering consultant.

•

The Electric Products Company has established a new Cleveland District office with headquarters at the factory on 1725 Clarkstone Road, Cleveland. This district is headed by G. J. Doss and the territory consists of Western New York and Pennsylvania, Ohio, West Virginia, Kentucky and Tennessee.

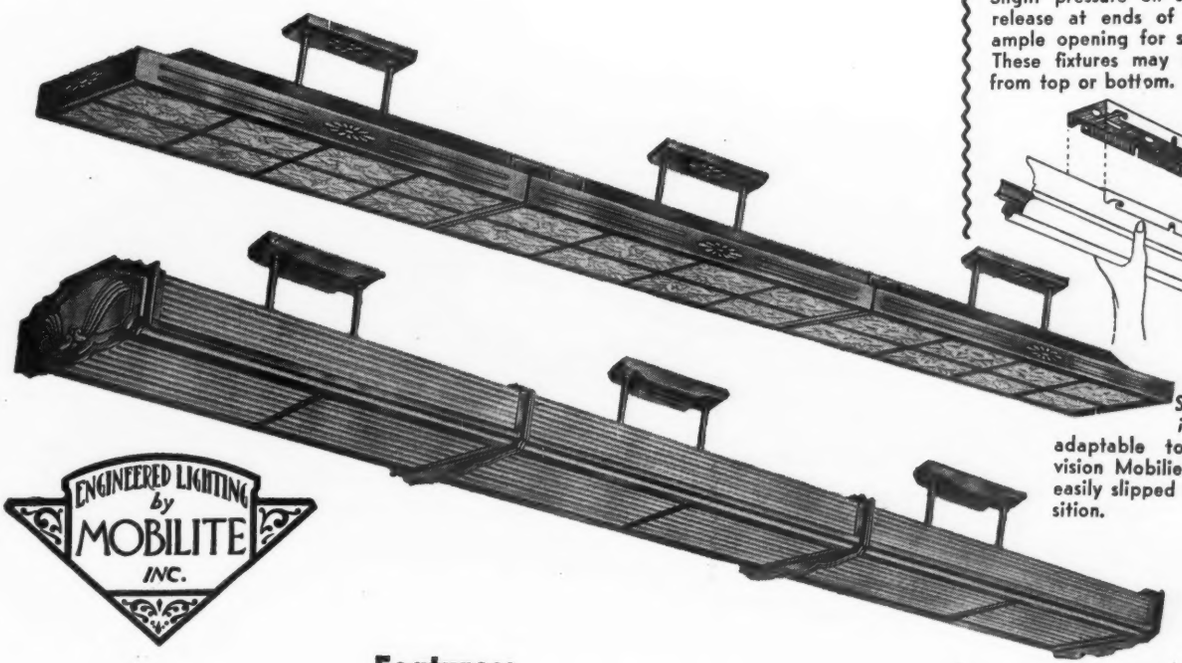
•

W. W. Powell, formerly with the General Electric Supply Corporation and for eight years sales manager for Coast Electric Company of San Diego, has organized a new wholesale electrical firm, the **Southwestern Electrical Supply Corp.,** San Diego, Calif.

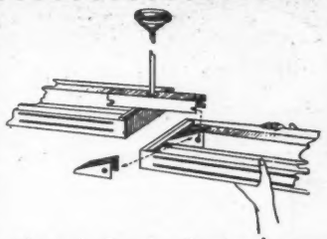
Increase Your Lighting Sales

with "SUPERVISION-MOBILIERS"

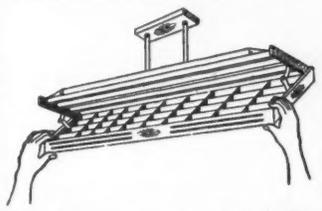
BRING IN THE BUSINESS by stocking this fast selling line of outstanding fixtures . . . Superior for their sensible, practical design, their smart good looks, and remarkable versatility . . . "SUPER-VISION MOBILIERS" meet the requirements for every type of fluorescent lighting.



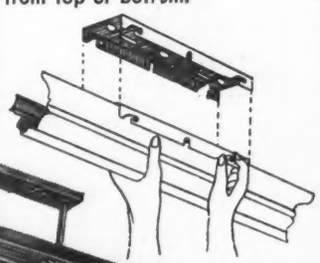
ENGINEERED LIGHTING by MOBILITE INC.



Channel Construction and continuous run assembly. Individual units are easily converted into continuous run fixtures by means of continuous run connector.



Slight pressure on spring button release at ends of unit permits ample opening for servicing . . . These fixtures may be relamped from top or bottom.

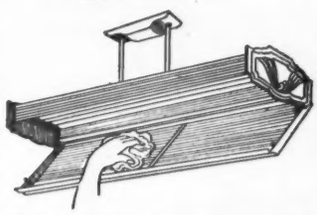


Surface Mounting Bracket— adaptable to all Supervision Mobiliers. Fixture is easily slipped into firm position.

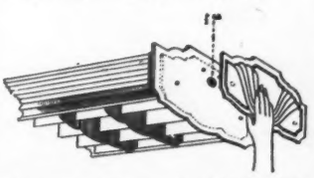
Features:

1. **MAXIMUM LIGHTING EFFICIENCY**
   Super-Vision units are designed for maximum efficiency . . . to provide high transmission and efficient diffusion eliminating shadows and contrasts.
2. **SMART STREAMLINED APPEARANCE**
   Artfully designed with sculptured pressed glass panels . . . modern louvres . . . glossy enamels . . . satin silvers . . . Alumalite trim and other features.
3. **DIVERSIFIED USEFULNESS**
   Super-Vision Mobiliers can be used for high or low ceilings or under balconies . . . or as Suspension Units, Surface Mounted Units or for Continuous Run.
4. **EASE OF INSTALLATION**
   Specially designed surface mounting brackets are furnished to facilitate hanging; sturdy construction and frames permit easy handling in opening and closing.
5. **MINIMIZED MAINTENANCE**
   Power plant (reactors, lamp holders, wiring assemblies) can be removed, replaced or repaired without removing the entire unit from hanging position.

Write for Catalog J



Slight pressure on spring button release at ends of unit permits ample opening for servicing.



All ornaments on Mobilier Units are easily removable for continuous runs by removing two nuts from end plate.
Single units are readily convertible to continuous run by removing ornamental end as illustrated above.

MOBILITE INC.

440 Mercer St.,
Jersey City, N. J.

Commutators!

DISTRIBUTORS CARRYING STOCK

INSULATION & WIRES INC.
3435 Chouteau Ave.
St. Louis 3, Missouri
25 W. Broadway
New York 7, N. Y.
30 Trowbridge Ave.
Detroit 2, Michigan
1040 Tremont St.
Boston 2, Mass.
289 Simpson St. N.W.
Atlanta 3, Georgia
317 N. Main St.
Houston 2, Texas

TRI-STATE SUPPLY CORPORATION
318 Occidental Ave.
Seattle, Washington
544 S. San Pedro St.
Los Angeles, California
554 Bryant St.
San Francisco, Calif.

GENERAL PARTS & SUPPLY CO.
618-620 Third Ave.
Minneapolis, Minn.

Sales Representatives Only

MANUFACTURERS SPECIALTIES, INC.
312 E. Wisconsin Ave.
Milwaukee 2, Wis.

A. J. ELLIS CO.
20 E. Jackson Blvd.
Chicago 13, Illinois

AVAILABLE
FROM STOCK...

REPAIR SHOPS...NOTE

A FACTOR OF PARAMOUNT IMPORTANCE WHEN PROMPT SERVICE IS ESSENTIAL

ALL TYPES
ALL SIZES
TO MEET YOUR REQUIREMENTS

FOR PROMPT SERVICE CONTACT YOUR NEAREST DISTRIBUTOR

SEND IN OLD CORES OF BOLT OR NUT TYPE CONSTRUCTION FOR REFILL

SPECIAL SIZES CAN BE MADE FROM YOUR SAMPLES OR SKETCHES

SEND FOR OUR CATALOG LISTING COMPLETE DIMENSIONS OF ALL TYPES OF COMMUTATORS

The Kirkwood Commutator Co.

Louis H. Wagner has joined the sales staff of **The Art Metal Company,** Cleveland, Ohio. Mr. Wagner was for seven years with the Associated Investment Company of South Bend, Ind. and the last five years with the Lamp Department of the General Electric Company in Cleveland and Cincinnati. His territory will cover Indiana, Kentucky, Ohio and West Virginia.

•

The Quadrangle Mfg. Co. announces the election of J. R. Gallaher as secretary of the Corporation and office manager to succeed Miss E. Laymon, who retired the first of this year.

•

General Controls Co. has announced the appointment of E. B. Maire as regional sales manager of its Mid-western, Southern and Eastern branch office territories, consisting of Boston, New York, Philadelphia, Pittsburgh, Detroit, Cleveland, Atlanta and Chicago.

•

United Electronics Company, Newark, N. J. has announced the appointment of John J. Glauber as chief engineer. He was formerly with Federal Telecommunications Laboratories of New York.

•

David G. Bender has joined the executive staff of **The Advance Transformer Company** of Chicago, as public relations director in charge of sales, advertising and public relations.

•

The American Coach & Body Co. of Cleveland, Ohio has announced the following sales appointments: Deming Bronson, sales manager, Central Division; Homer A. Feyen, sales manager, Midwestern Division; William R. Hall, sales manager, Eastern Division.

•

Earl S. Guild, former plant engineer at Ranger Aircraft Engines, Farmingdale, L. I., has joined the **BullDog Electric Products Co.,** Detroit, in the capacity of field engineer in the Washington, D. C. office.

•

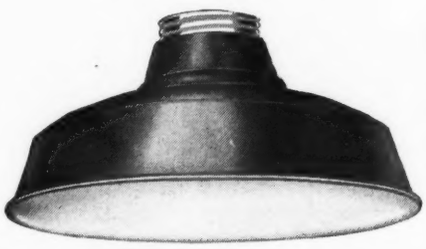
Clarence G. Wood has been named director of sales of the **American Coach & Body Co.,** Cleveland, Ohio. Mr. Wood joined the company early in 1946 as manager of sales promotion.

•

The Radix Wire Co., Cleveland, has moved into a larger plant at 2800 E. 55th Street.

QUAD
LIGHTING UNITS

RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods



RLM Threaded Dome Reflector

QUADRANGLE 400 WATT RLM

TYPES

TO MEET ALL INDUSTRIAL AND COMMERCIAL NEEDS

- **Socket type for applications where high intensity illumination is needed over a small working area or where conditions require high mounting.**

Threaded reflectors and socket hoods where atmospheric and working conditions make frequent cleaning necessary. Easy to remove or interchange the various types of reflectors with no disturbance to electrical connections.

QUAD design is your answer for immediate good business and for full customer approval.

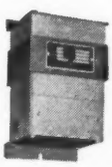
- ***Sold thru Electrical Wholesalers*** -

QUADRANGLE MFG. COMPANY
32 S. PEORIA ST.
CHICAGO 7 ILLINOIS

SORGEL
AIR-COOLED
TRANSFORMERS

Steel Encased

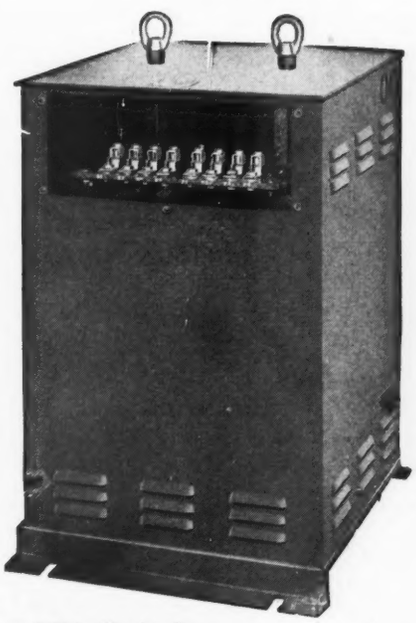
A size and type for every purpose
¼ KVA to 1000 KVA.
All Voltages
Single phase and polyphase



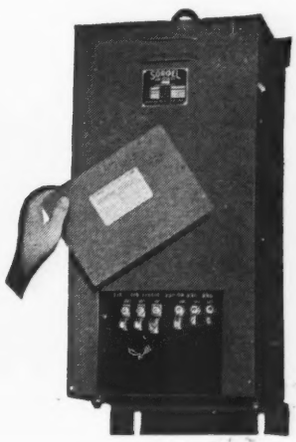
¼ KVA
Single Phase
460/230 to
115 volt

Write for
Bulletin No. 1246
Describing and Illustrating our latest and most complete line of Air-Cooled Transformers

5 KVA
Wall Mounting Type



50 KVA. Single phase.
Floor Mounting Type.
With cover of connection compartment removed, showing solderless terminals.



15 KVA. 3-phase
Wall mounting type.
Showing connection compartment with solderless terminals

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wisconsin

Pioneers in the development and manufacturing of Air-Cooled Transformers

IT'S VERSATILE—Used for detecting and diagnosing trouble in nearly all types of electrical equipment including: motors, generators, transformers, switchboards, appliances, lighting circuits, meters and relays . . . practically *everything* electrical.

IT'S EASY TO OPERATE—Simply make connections, turn the crank and take a direct reading. It's as simple to read as a voltmeter. Ratings up to 50 megohms, 500 volts.

IT'S CONVENIENT—Requires no external power supply, no adjustments, no batteries or replacement parts. DC test current is supplied by a self-contained hand-operated generator—an unfailing source, *always* ready for use.

IT'S INSURANCE—Insulation testing with a "Megger" Tester is your first line of defense in electrical preventative maintenance . . . your protection against moisture and other enemies of electrical insulation . . . a *must* in your struggle for uninterrupted electrical service.

* Trademark Reg. U. S. Pat. Off.

READ THIS BULLETIN . . . Here's the ABC of the Midget "Megger" Insulation Tester, telling briefly and in common sense language just what the Midget "Megger" Tester is, how it is used . . . AND . . . what it will do for you. Write for your copy of Bulletin 1785-EC *today*.

James G. **BIDDLE CO.**

ELECTRICAL & SCIENTIFIC INSTRUMENTS

1316 ARCH STREET • PHILADELPHIA 7, PENNA.

INDUSTRIAL LIGHTING TECHNIQUES

[FROM PAGE 76]

Spacing of units controls the type of light distribution required for various mounting heights to some extent, hence the overlap of mounting heights given above.

Footcandle levels also affect the spacing of units, type of distribution and size lamps required. All three factors must be considered when planning the lighting layout. Mounting heights and spacings are often governed by structural conditions. Flexibility in lamp sizes and light distribution make it possible to meet these limiting factors in most cases.

Special Applications. Lighting of certain machine operations or processes often require special analysis. A specific color quality illumination may be required. Directional control of light may be necessary. An exceptionally high intensity over a small area may be called for. Economy may dictate local lighting on the work area. It may be necessary to provide explosion-proof equipment, such as for paint spray booths. There are so many lightng problems requiring special consideration that it is impossible to discuss them in detail here. Unless enough is known about such problems and the types of equipment available to solve them properly, they should be referred to manufacturers of the proper types of equipment for such applications.

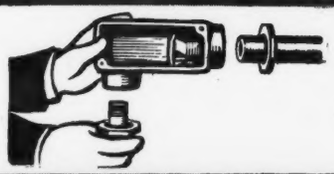
TABLE I—Recommended* Industrial Lighting Intensities

Seeing Tasks	Footcandles
Rough Manufacture	10 to 30
Medium Fine Assembly, Inspection, Etc.	30 to 100
Critical Visual Tasks, Extra Fine Assembly, Inspection, Etc.	100 and more

*See "American Recommended Practice of Industrial Lighting", published by Illuminating Engineering Society.

Color Quality. Incandescent lamps produce an inherent "warm" light, which means its visible radiation contains an over abundance of orange and yellow rays of light as compared with average daylight. Objects seen under this light will also appear yellow in comparison with their appearance in natural daylight. With incandescent lighting, color correction is accomplished by the subtractive method; that is, filters are used on the

They use RIGID and THIN-WALL conduit



They often have to CHANGE FITTINGS

Fittings must resist constant VIBRATION

What a Spot for KONDU!

Only with Kondu fittings can you use Thin-Wall Tubing at any outlet . . . and take one fitting out of the line and put in another, without disturbing conduit. And Kondu fittings hold permanently tight . . . vibration proof. Practically unbreakable . . . 100% re-usable.

Write for the Kondu Catalog

KONDU CORPORATION
Erie, Pa.

KONDU MFG. CO. LTD., Preston, Ontario

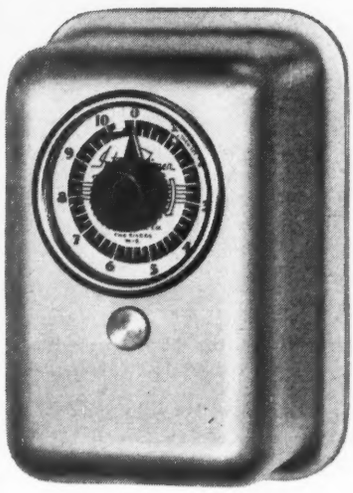
KONDU

The Threadless Fitting Line of Unequalled Variety

New ATTIC FAN TIMER by Paragon

Here's a new member

of the Paragon family . . . the AF Series for timing attic and window fans.



Entirely new in design, this timer is offered in two time ranges, 0-10 hours and 0-20 hours, each fully adjustable to any position on the dial . . . a real convenience for the user.

Equipped with a quiet Telechron motor and an improved switch, the timer is rated for high capacity, and will handle a ½ HP motor. Beautifully finished drawn aluminum case, anodized, with dial and pointer protected by clear Plastacele.

Underwriter approved, all electric, no springs, mounts easily to Handy box or single gang switch box, or may be surface mounted with conduit connections into the bottom of the timer. The setting may be changed at will without harming the instrument. Timer motor runs only when timer is actually in operation.

Get your orders to your jobber—now and start planning installations early. Complete data sheet on request.

AT ONLY $9.75 AN OUTSTANDING VALUE

PARAGON ELECTRIC COMPANY
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TWO RIVERS, WISCONSIN

Paragon Two Rivers WISCONSIN
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

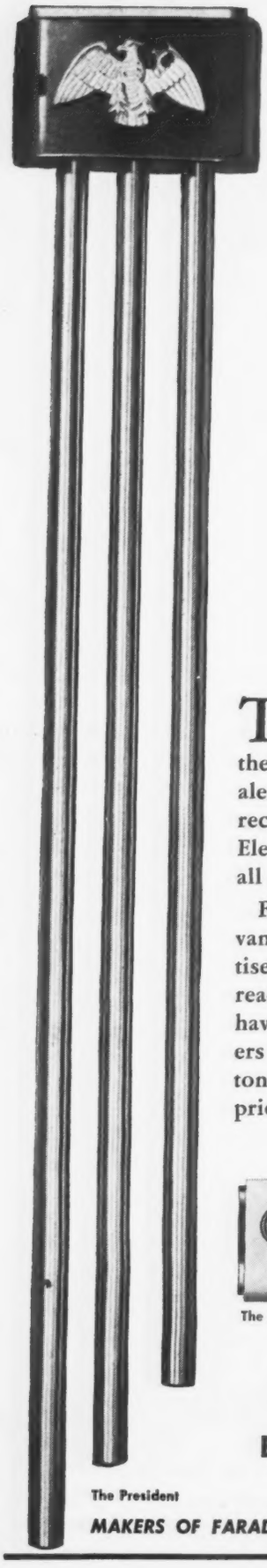
Make friends and make money

with famous

FARADAY

SWEET-TONED

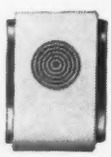
CHIMES



THE ladies have *approved* their styling, tone and quality—and performance has *proved* their positive, trouble-free action. That's why alert, profit-wise contractors everywhere are recommending and installing Faraday Chimes. Eleven beautiful new models offer harmony with all decorating schemes.

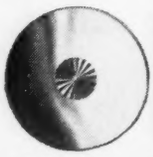
Faraday Chimes bring you other valuable advantages, too. They have been nationally advertised in the best-read magazines and thus are readily accepted. And Faraday tubular models have the new exclusive "tone crown" tube hangers (all metal—no strings) which assure richer tones and a minimum of swinging. Fair trade prices, $3.95 up.

Write today for full information!



The Savarin

The St. George



The Madison

The Burgundy

The President

FARADAY

ELECTRIC CORPORATION

ADRIAN, MICHIGAN

MAKERS OF FARADAY BROILMASTER, PLUGMASTER AND SIGNALS

reflectors to subtract enough yellow and orange rays from the incandescent light to provide a white light which more nearly approaches daylight in color quality. It may prove, upon thorough analysis, that other light sources such as flourescent or mercury vapor will produce a better color quality on a more economical basis.

Lighting Layouts. Assuming standard size bays, such as 20 ft. by 20 ft., there are three basic layouts for incandescent lighting systems: (1) symmetrical, (2) staggered, and (3) special, for specific lighting of individual machines or operations. The symmetrical layout is favored for general lighting. Staggered layouts have the disadvantage of leaving unevenly lighted areas along the walls. Special spacing relative to machine operations are usually more efficient in producing higher intensities where wanted, and is satisfactory when machines are permanently located. A system of general illumination should also be provided where special mounting of equipment at machines is used, to prevent undue brightness contrasts.

Unequal bay sizes usually require special study. In general, the symmetrical layout will prove most satisfactory. It may be necessary to locate four units in one bay, and two in the next bay, without regard to symmetry of spacing within each bay. Trial and error is used for different size units and different spacing arrangements to arrive at the best solution.

Robert Dodge, associated with the Evans Motor Repair Company of Utica, New York, splices his motor winding with reminiscences of 48 years in the electrical industry. His experiences range from the Oklahoma Territory and Cherokee Strip to winding early model smooth-walled motor slots with coils of solid number 8 wire, tying the coils into place with waxed linen twine.

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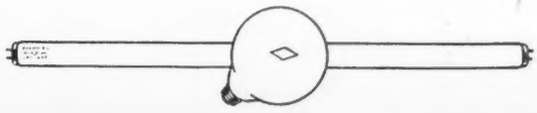
Reduced eyestrain, conserved nervous energy, sharply diminished accident hazards, infinitely pleasanter working conditions and improved morale — all are the result of good lamps and lighting.

Champion makes the lamps, specially for industrial service, and provides a consulting service on lighting engineering *without charge or obligation.*

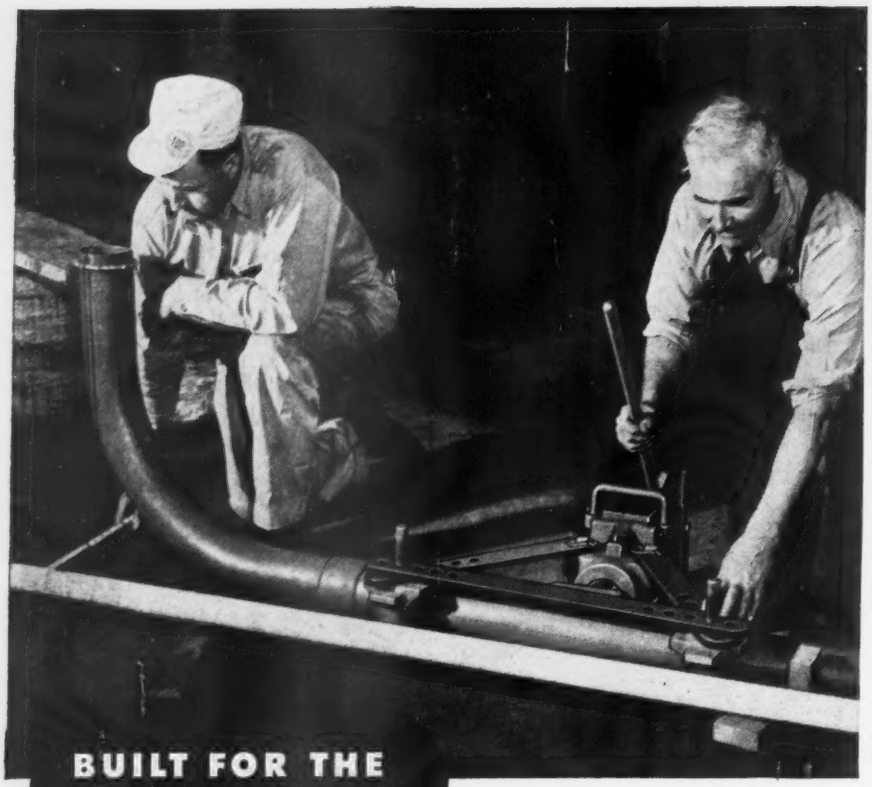
Champion industrial distributors are ready to supply your lamp needs with the utmost efficiency at lowest cost, lighting effectiveness and lamp performance considered.



CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO



BUILT FOR THE REALLY TOUGH JOBS

GREENLEE BENDER

Bending of big 4-inch pipe is taken right in stride by the GREENLEE Hydraulic Bender shown above, on the job for Paul H. Jaehnig, Inc., Electrical Contractors, Newark, New Jersey.

It's one of the 12 GREENLEE Benders owned and regularly used by that company. And, as they report, "It has the strength for tough work . . . does the job very efficiently."

Yes, you'll find your GREENLEE a husky, hard-working dependable piece of timesaving equipment that calls for practically no maintenance. And on every job the GREENLEE brings real savings . . . in time, manpower, materials. For, with a GREENLEE *one man* quickly and easily makes accurate bends in pipe *up to* 4½", rigid and *thin-wall* conduit, tubing, bus-bars. It's compact, portable, easy to set up and operate where and when you want it. Often pays for itself on the first few jobs!

Whatever your bending job, there's a GREENLEE Hydraulic or Hand Bender to do it. Write today for complete information. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1743 Columbia Avenue, Rockford, Ill.

TOOLS FOR CRAFTSMEN

GREENLEE

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pusher

A MERCOID UNFAILING ADVANTAGE

Whatever your control requirements may be, it is conceded that the switch in a control warrants first consideration, due to its functional characteristics. All Mercoid Controls are equipped exclusively with hermetically sealed mercury switches of special design and selected materials.

Mercoid mercury switches are known the world over for their dependable service. They are not affected by dust, dirt or corrosion; nor are they subject to open arcing with its attendant consequences of pitting, sticking or oxidized contact surfaces, all of which, are likely to interfere with normal switch operation.

That is why among other things, Mercoid Controls on the whole give you assurance of better control performance and longer control life—a distinct and unfailing advantage—the reason why they are also the choice of America's leading engineers for many important industrial applications.

MERCOID CONTROLS are available in a variety of types for sensitive control of Pressure, Temperature and Lever actuation.

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APPROVED CONTROLS

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SPERO
DEPENDABLE
ELECTRICAL PRODUCTS

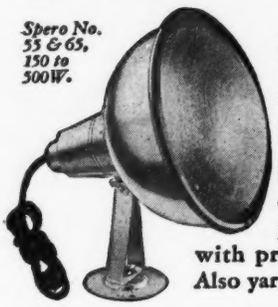
Spero offers you the convenience of 5 complete lines of electrical products from one reliable source.

1 VAPOR PROOF UNITS

Pendant or bracket types, for 3″ and 4″ outlet box or "x" Type mounting. With or without wire guard and reflector. 50 to 300 W.

2 FLOODLIGHTS

Spero No. 55 & 65, 150 to 500W.



Finishes in "Duralum"—sizes for lamps from 150 to 1500 W. Open types or outdoor weatherproof type with prismatic lens. Also yard lights.

3 REFLECTORS

Shallow and dome-type, one-piece seamless construction, keyless or with pull chain. For 25 to 750 W lamps.

Dome type for 60 to 200 W lamps.

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Die-Cast Sockets with approved porcelains are just one of the items we manufacture for use in electrical construction.

Vertical or 90° angle mounting.

5 FLUORESCENT FIXTURES

SPERO also manufactures more than 30 types and sizes of fluorescent units.

Spero products are distributed only through recognized wholesalers. Write for Bulletin No. 10.

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GEDNEY FITTINGS ...FIT! Do a good job ...FASTER!

ASK YOUR WHOLESALER!

Every electrician and contractor worth his salt watches the little things—like fittings . . . because they figure BIG on wiring jobs done *right!* That's the reason for GEDNEY care in turning out fittings that help you come out "on top".

★ HIGH GRADE MALLEABLE IRON
★ SMOOTH FINISH—INSIDE AND OUT
★ CLEAN ACCURATE THREADING
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Conveniently packaged and clearly labeled for instant selection of the proper size and type for your job. UL approved. Look for the familiar box with the all-over GEDNEY trademark pattern and sturdy metal edges.

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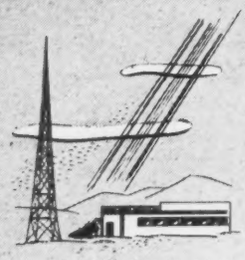

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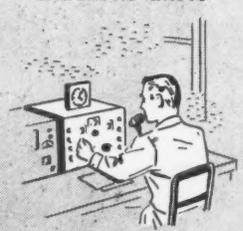

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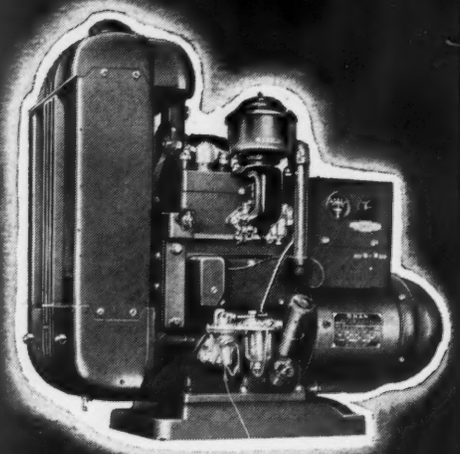
"SPOT" RECORDING

A.C. OR D.C. POWER

PORTABLE, STANDBY OR STATIONARY for *Electronics Uses*



Onan Electric Plants are completely self-contained, dependable power units built in a wide range of sizes and standard voltages.

Lightweight, one or two-cylinder, air-cooled models offer the maximum in portability for many applications. Portable A.C. models—350 to 3,000 watts; portable D.C. models—600 to 5,000 watts.

Although widely used for intermittent service as standby units, Onan two, four, and six-cylinder water-cooled plants are built for continuous heavy-duty operation . . . stationary or mobile. A.C. models—3 KW to 35 KW; D. C. models—3.5 KW to 10 KW.

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ONAN Electric Plants are available in many sizes and models. ALTERNATING CURRENT: 350 to 35,000 watts in all standard voltages and frequencies. DIRECT CURRENT: 600 to 10,000 watts, 115 and 230 volts. BATTERY CHARGERS: 500 to 3,500 watts; 6, 12, 24 and 32 volts.

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sales-making prices
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feature . . . .

BERNS AIR KING

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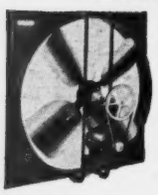

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DIRECT DRIVE BLOWER

SHORT PEDESTAL AIR CIRCULATOR

BUILT-IN TYPE KITCHEN FAN

SOLD EXCLUSIVELY THROUGH LEADING ELECTRICAL WHOLESALERS

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EXHAUST FANS • AIR CIRCULATORS
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For Planned Wiring...

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Every good workman appreciates high quality in the tools and equipment he uses. To a lineman, however, this regard for quality is more than admiration for fine craftsmanship. The lineman daily trusts his very life to his safety strap, belt and climbers—and under such conditions high quality is more than a matter of pride.

Good workmen know that there's no substitute for experience. It is the years of expert craftsmanship back of every piece of Klein equipment that make Klein belts and safety straps—Klein climbers and grips—Klein pliers and wrenches the first choice of linemen today as they have been "since 1857."

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Since 1857

This book on the care and safe use of tools will be sent on request.

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IRVINGTON INSULATIONS

For the motor repair contractor—or the electrical maintenance shop—IRVINGTON supplies *all* flexible varnished insulation requirements.

IRVINGTON INSULATING VARNISHES—synthetic varnishes of high dielectric strength and moisture resistance . . .

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IRV-O-SLOT—easy forming, non-bulking slot insulation . . .

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VARNISHED TUBING and SATURATED SLEEVING—for insulating lead wires . . .

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Test samples and further information on these Irvington insulations on request.

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SAFE

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THE NEW McGILL *Vaporproof*

Portable Lamp Guard . . . strong, portable, sealed. It is water-tight, vapor-tight, dust-tight and moisture proof. The plastic handle, and fibre cage are shock proof and non-sparking. **A rubber gasket has now been placed between the cage and handle, and absorbs all stress and strain, preventing breakage.** The heavy glass protecting globe eliminates possibility of breakage of the lamp bulb inside from splashing liquids. Being air-tight these guards are perfectly safe for use where vapor and dust infused air is prevalent. They have no equal for safety, service and convenience around flour mills, paint booths, finishing rooms, airports, warehouses, food processing plants, shipyards, aboard ships, and many other places.

The No. 3007 has the plastic cage. The No. 3006 has a heavily tinned, electrically welded wire cage.

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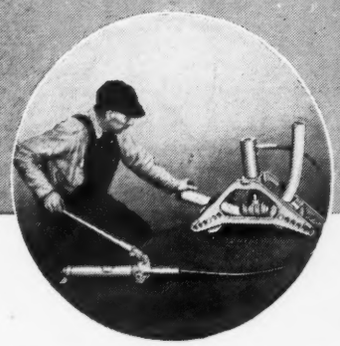
You get

ALL THREE *with a*

BLACKHAWK

PIPE BENDER



Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that performs this triple job:

1 PIPE BENDING

Bends rigid conduit and pipe of all popular diameters. Saves need for elbows, couplings and extra cutting and threading.

2 MAINTENANCE and PRODUCTION

Porto-Power pushes, pulls, bends, presses, spreads, and clamps—pulls gears, lifts machinery and licks scores of other jobs.

3 SPECIAL JACK

Compact Hydraulic Ram works in all directions — at any angle. A versatile, safe, remotely controlled jack.

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WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS

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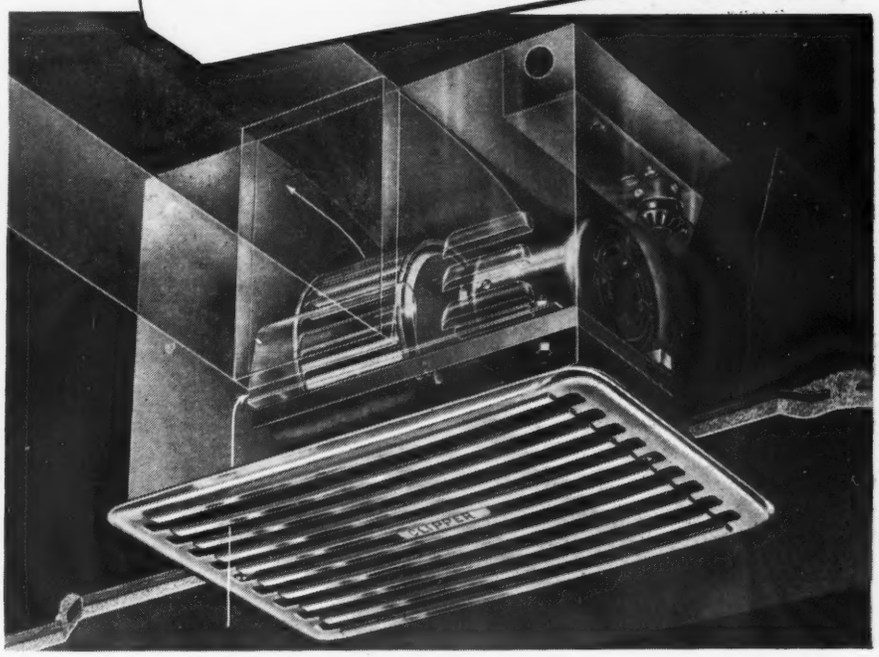
PACKAGED VENTILATION FOR SMALL ROOMS



CLIPPER BLOWERS

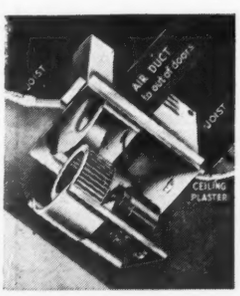
Here's a complete, packaged ventilating unit that is engineered to do a big job in small rooms . . . and make a good profit for you.

The Clipper is specially designed for ventilating kitchens, bathrooms, ticket booths, X-ray rooms, toilets, clinics and other small rooms.

Clipper Blowers are mounted between ceiling joists and vented outside. They trap and expel unwanted air, heat and odors the instant they rise.

The Clipper is NOT a blade-type fan, but a quiet squirrel cage blower that moves a volume of air under pressure. Its patented construction with the motor entirely removed from the air stream, means greater efficiency, longer life, easier servicing.

Ask your jobber for details of the Clipper Sales Plan or write us for complete information.



The Clipper is a complete packaged ventilator which is hidden in the ceiling. Only an inconspicuous "dripless" ceiling grille is visible, yet motor and blower assembly are instantly removed without tools for service.

TRADE-WIND MOTORFANS, INC.

5709 S. MAIN ST., LOS ANGELES 37, CALIF.

RELIANCE AUTOMATIC TIME SWITCHES

Model "W"

Completely automatic . . . extremely simple, compact, economical . . . three types cover practically every requirement . . .

ASTRONOMIC TIME SWITCH

• The Model "W" Astronomic types are particularly popular for advertising illumination. The "on" operation changes daily to correspond with local sunset time, eliminating the necessity of resetting the dial as the days become longer or shorter.

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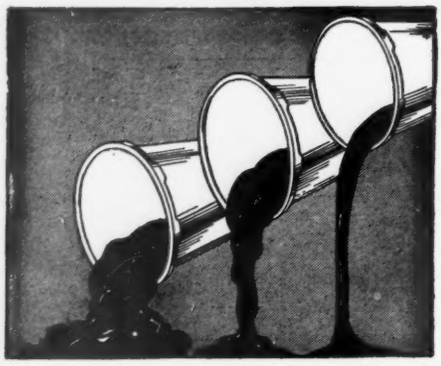
RELIANCE Time Switches have proved their dependability. They give complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential. Send for catalog and price sheets for complete details.

RELIANCE AUTOMATIC LIGHTING CO.
1907 MEAD STREET RACINE, WISCONSIN

Insulating and Cable-Pulling

COMPOUNDS

of Record-Breaking Performance



Minerallac gives you a complete assortment for every need: dense, viscous and fluid consistencies for high and low voltages in cable-joints, pot-heads, terminal bills, distribution cables, street lighting, telephone work. . . . Insoluble in oil or water, for all temperatures. Clean, safe, economical—outranks all others in quality.

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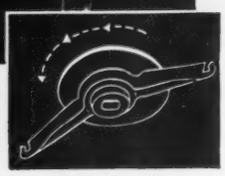
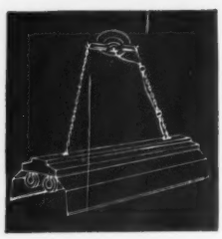


360° Adjustment

NEW "Friction-Set" FIXTURE HANGER . . .

That Adjust With a Twist of the Wrist!

At last you can get a Fixture Hanger that turns to any angle after being screwed to an outlet box. Although base and receptacle remain stationary, hanger arms may be turned to align with any preconceived lighting plan. Exclusive Friction Ring firmly holds fixture in selected position. Hanger screws on to 3¼" or 4" outlet boxes, no other fastening necessary. Furnished complete with receptacle, two 5' chains, hooks and cord clips.



For any fixture position

Friction-Set K100 . . . List Price $1.10

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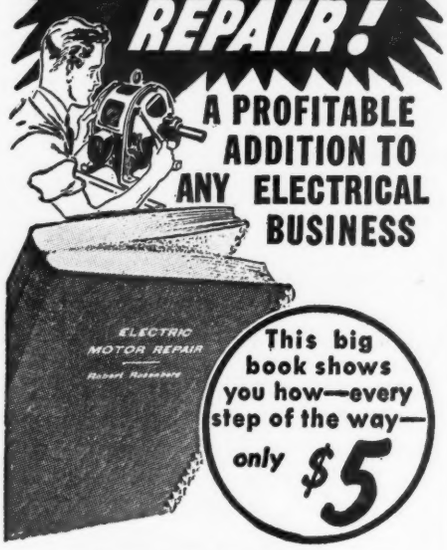

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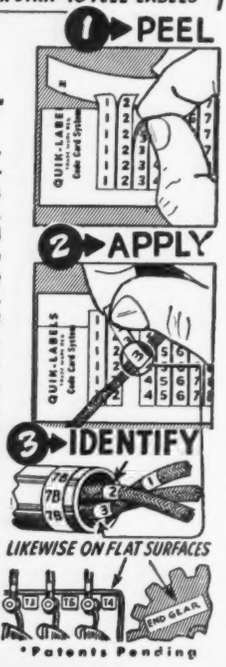

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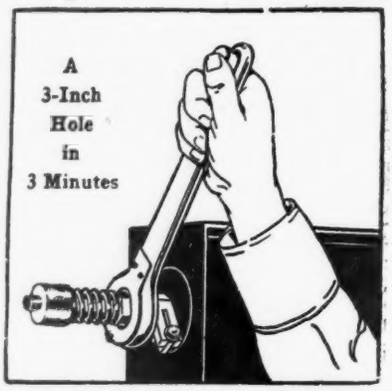

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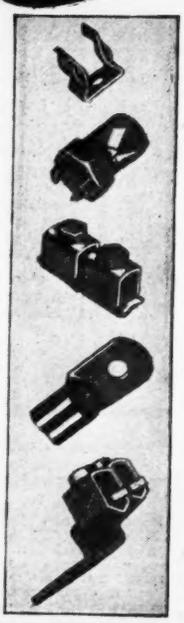

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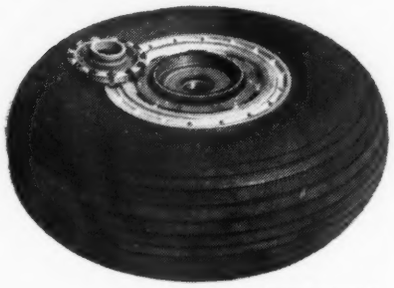

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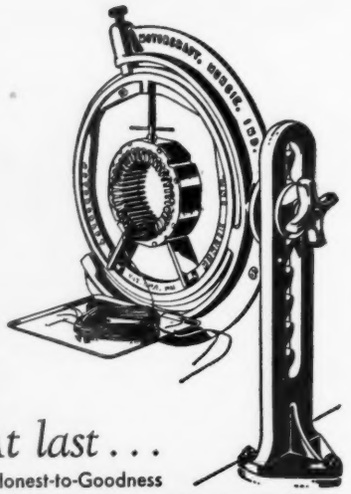

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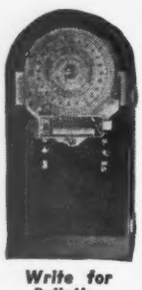

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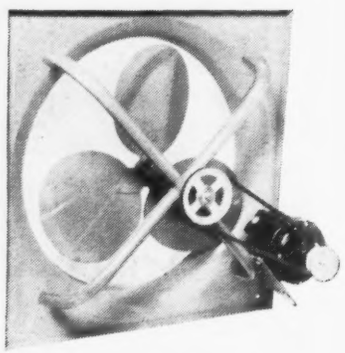

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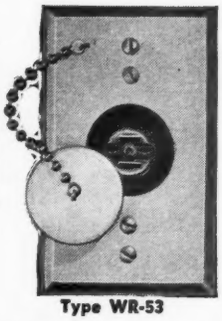

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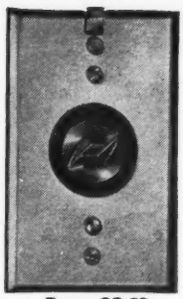

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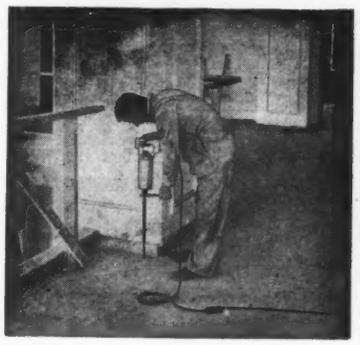

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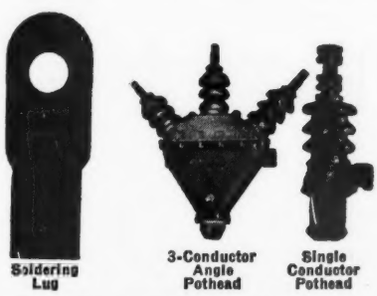

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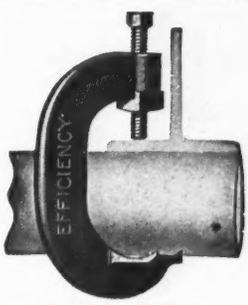

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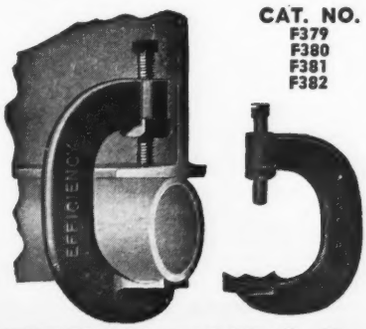

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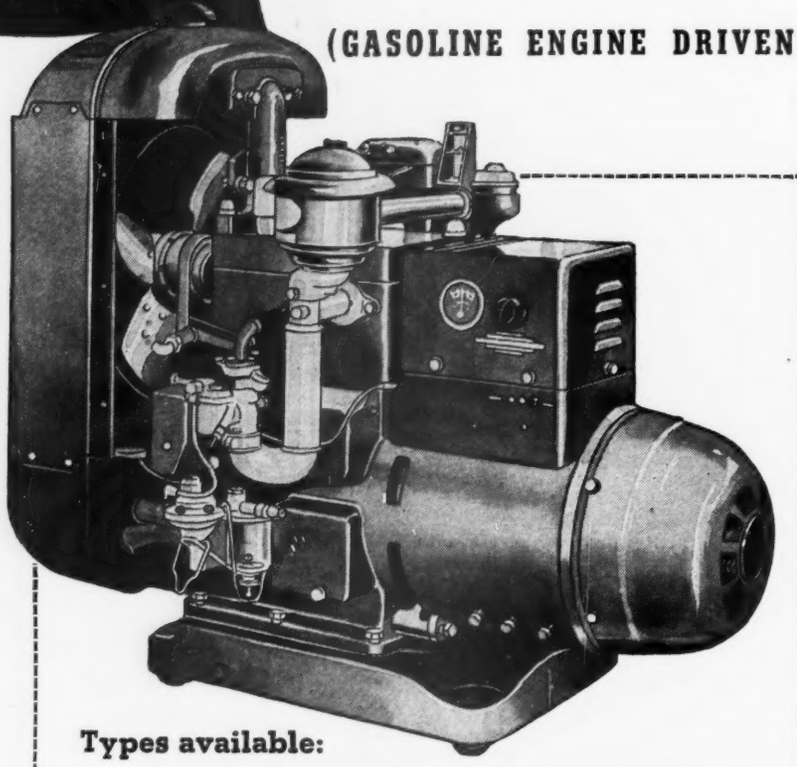

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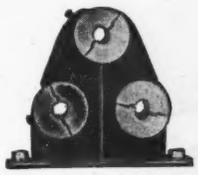

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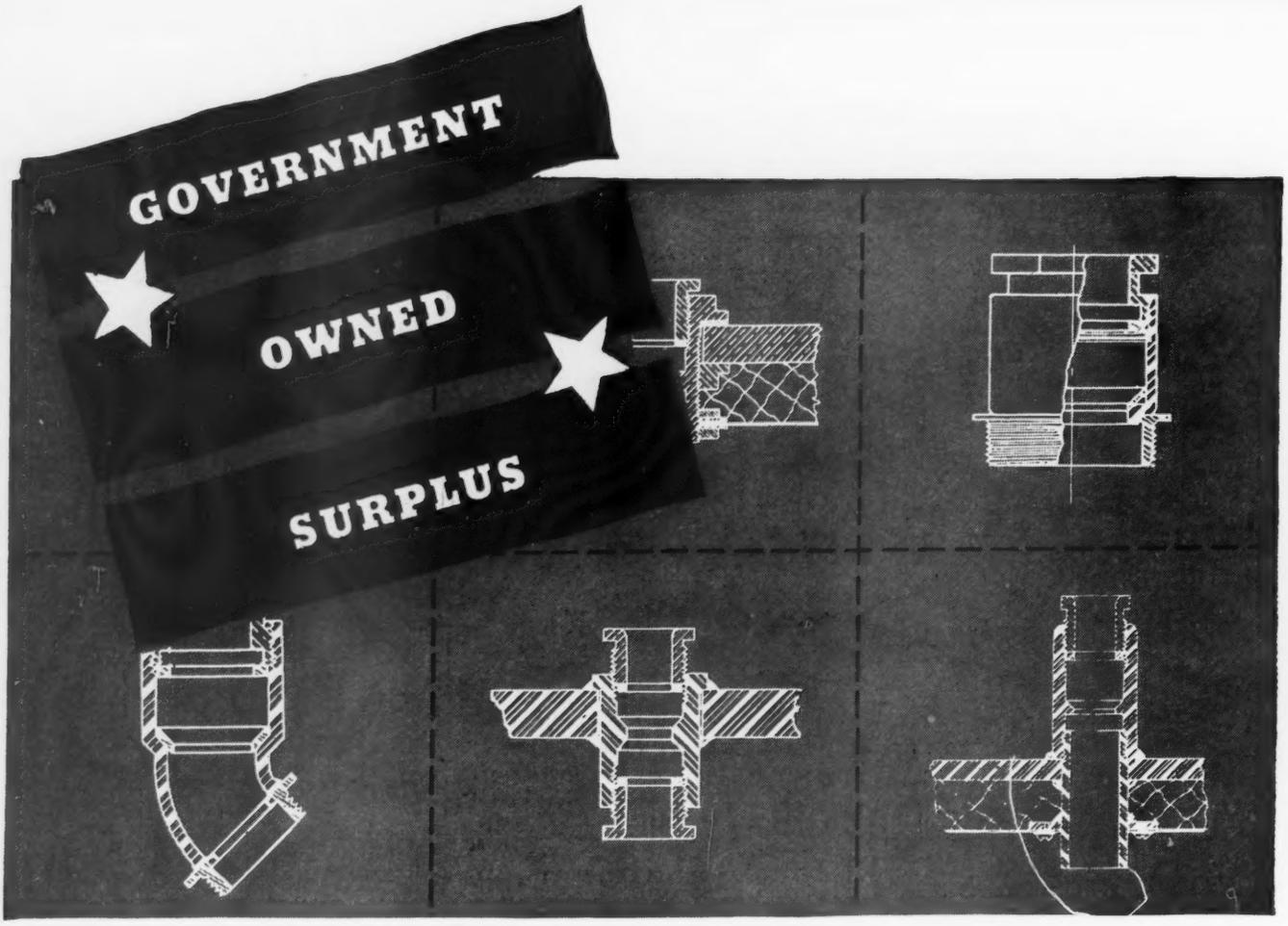
4627 W. Huron St. Chicago 44, Ill.

Telephone AUstin 9866



NAVY TYPE TERMINAL AND STUFFING TUBES

SEALED BID SALE

If you use or sell fittings to take electric cable through walls, ceilings, floors, decks, bulk-heads, housings, tanks, etc., here are items you can use. The component parts are made of Brass, Steel, Bronze or Aluminum and may be adapted to the production of a variety of industrial equipment. Best quality (used for battleships and submarines during the war) and at a price *you* set yourself. $1,200,000 worth of these fittings will be placed on sealed bid sale in March. Make sure you have an opportunity to bid. Write today to each of the WAA offices listed below and ask to have bid offering lists mailed to you. Each of the listed offices will be conducting its own sales. You have 12 chances of being low bidder.

List of WAA offices conducting sales of Navy Type Terminal and Stuffing Tubes during March:

Atlanta • Birmingham • Boston • Los Angeles • Minneapolis • New York Portland • Richmond • Philadelphia • San Francisco • Spokane • St. Louis

NO PRIORITIES NEEDED

OFFICE OF GENERAL DISPOSAL

WAR ASSETS ADMINISTRATION

GOVERNMENT WAA SURPLUS

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha • Philadelphia • Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane • Tulsa

1030

AIRPORT LIGHTING EQUIPMENT

Many types of Airport and Airway lighting equipment including runway marker lights, cone assemblies, globes, portable field lighting sets and associated equipment, are now available.

Much of this equipment can be adapted to many uses calling for outdoor portable lighting fixtures.

Most of this inventory is offered on a sealed bid basis. You may bid on entire sets complete or on such parts as are specified in sealed bid offering lists. Some items are sold at fixed prices only.

Write to the Birmingham Regional Office requesting that your name be placed on their mailing lists when offerings are made of this type of equipment.

Adaptable to a Variety of uses

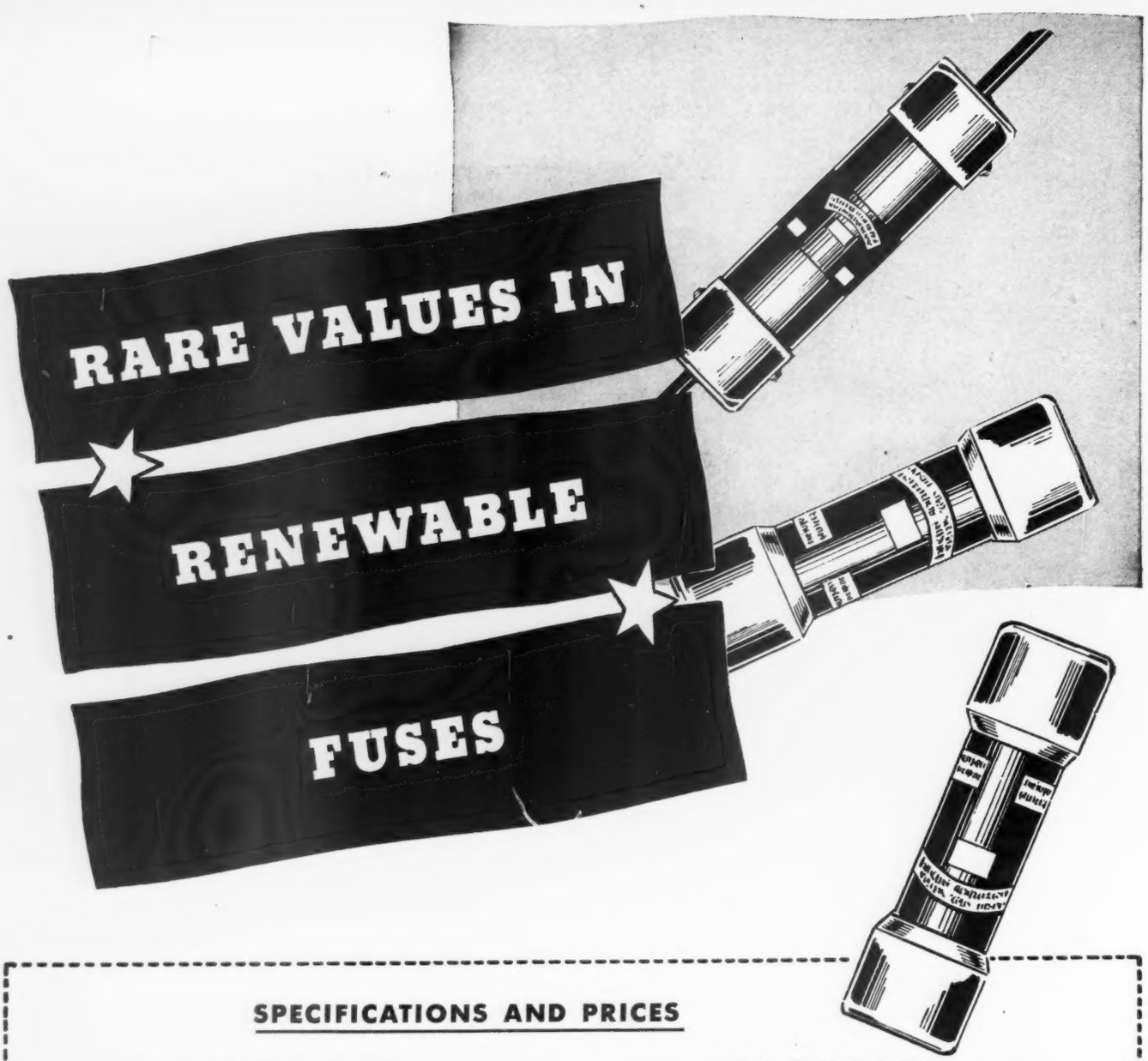
OFFICE OF GENERAL DISPOSAL

WAR ASSETS ADMINISTRATION

GOVERNMENT WAA SURPLUS

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha • Philadelphia Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane • Tulsa

1031



SPECIFICATIONS AND PRICES

250 Volts Ferrule Contact Fuses

AMPERAGE	Unit	Wholesaler	Retailer Small	Retailer Large
3 Amperes	Each	$ .10	$ .14	$.135
6 Amperes	Each	.10	.14	.135
10 Amperes	Each	.10	.14	.135
15 Amperes	Each	.10	.14	.135
20 Amperes	Each	.10	.14	.135
25 Amperes	Each	.10	.14	.135
30 Amperes	Each	.10	.14	.135
35 Amperes	Each	.20	.28	.27
40 Amperes	Each	.20	.28	.27
45 Amperes	Each	.20	.28	.27
50 Amperes	Each	.20	.28	.27
60 Amperes	Each	.20	.28	.27

600 Volts Ferrule Contact Fuses

AMPERAGE	Unit	Wholesaler	Retailer Small	Retailer Large
3 Amperes	Each	.25	.35	.335
6 Amperes	Each	.25	.35	.335
10 Amperes	Each	.25	.35	.335
15 Amperes	Each	.25	.35	.335
20 Amperes	Each	.25	.35	.335
25 Amperes	Each	.25	.35	.335
30 Amperes	Each	.25	.35	.335
35 Amperes	Each	.40	.56	.54
40 Amperes	Each	.40	.56	.54
45 Amperes	Each	.40	.56	.54
50 Amperes	Each	.40	.56	.54
60 Amperes	Each	.40	.56	.54

250 Volts Knife Blade Contact Fuses

AMPERAGE	Unit	Wholesaler	Retailer Small	Retailer Large
70 Amperes	Each	$ .45	$ .63	$ .60
80 Amperes	Each	.45	.63	.60
90 Amperes	Each	.45	.63	.60
100 Amperes	Each	.45	.63	.60
110 Amperes	Each	1.00	1.40	1.33
125 Amperes	Each	1.00	1.40	1.33
150 Amperes	Each	1.00	1.40	1.33
175 Amperes	Each	1.00	1.40	1.33
200 Amperes	Each	1.00	1.40	1.33
225 Amperes	Each	1.80	2.52	2.40
250 Amperes	Each	1.80	2.52	2.40
300 Amperes	Each	1.80	2.52	2.40
350 Amperes	Each	1.80	2.52	2.40
400 Amperes	Each	1.80	2.52	2.40
450 Amperes	Each	2.75	3.85	3.67
500 Amperes	Each	2.75	3.85	3.67
600 Amperes	Each	2.75	3.85	3.67

600 Volts Knife Blade Contact Fuses

AMPERAGE	Unit	Wholesaler	Retailer Small	Retailer Large
70 Amperes	Each	$ .90	$1.18	$1.12
80 Amperes	Each	.90	1.18	1.12
90 Amperes	Each	.90	1.18	1.12
100 Amperes	Each	.90	1.18	1.12
110 Amperes	Each	1.75	2.45	2.33
125 Amperes	Each	1.75	2.45	2.33
150 Amperes	Each	1.75	2.45	2.33
175 Amperes	Each	1.75	2.45	2.33
200 Amperes	Each	1.75	2.45	2.33
225 Amperes	Each	3.50	4.90	4.65
250 Amperes	Each	3.50	4.90	4.65
300 Amperes	Each	3.50	4.90	4.65
350 Amperes	Each	3.50	4.90	4.65
400 Amperes	Each	3.50	4.90	4.65
450 Amperes	Each	5.00	7.00	6.65
500 Amperes	Each	5.00	7.00	6.65
600 Amperes	Each	5.00	7.00	6.65

All Fuses F.O.B. Location

PRIORITY BUYERS—VETERANS—COMMERCIAL BUYERS—EXPORTERS

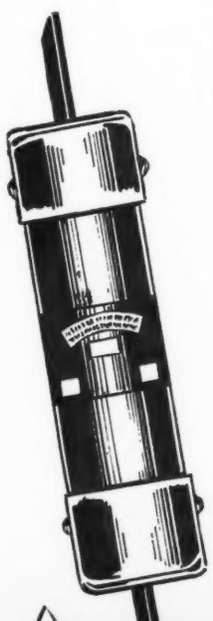
GOVERNMENT OWNED SURPLUS

FIXED PRICE SALE AT LESS THAN MANUFACTURER'S PRICES!

FERRULE AND KNIFE BLADE CONTACT TYPES

Fifty-eight different types of these protective electrical devices are included in this surplus property offering. Made by various manufacturers, these fuses operate in the conventional manner and provide protection from short circuits and heavy overloads for many types of wiring equipment. They require no attention, occupy a small space, can be easily recharged when blown and instantly replaced. All are in unused condition.

All regions have some inventory, but not all regions have all sizes and types listed: check your nearest Regional Office for more complete information.



★ ★ ★

This is a concurrent and continuous sale. Ten percent of the total inventory will be reserved to fill orders received from Federal Agencies by 5 p.m. on March 25, 1947. All other orders received by 5 p.m. on this date will be filled in the following sequence: (1) Certified Veterans of World War II; (2) Subsequent priority claimants; (3) Non-priority purchasers.

ALL ORDERS received after this date will be filled without regard to priorities.

PAYMENTS must be made when requested, unless credit has been established in advance at WAA Regional Offices. Business checks or approved personal checks will be accepted.

PURCHASER'S ORDER must state thereon: "This order is subject to War Assets Administration standard conditions of sale and all other advertised terms and conditions and no other terms or conditions shall be binding on War Assets Administration."

EXPORTERS: Your business is solicited. Any inquiries regarding export control should be referred to Office of International Trade, Department of Commerce, Washington 25, D. C.

OFFICE OF GENERAL DISPOSAL

WAR ASSETS ADMINISTRATION

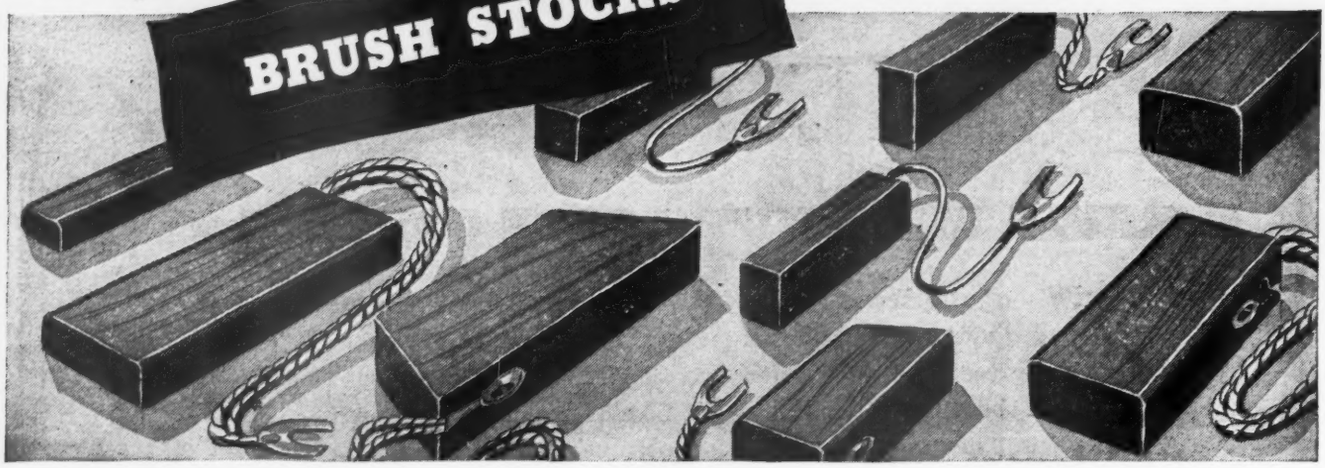
GOVERNMENT WAA SURPLUS

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha • Philadelphia • Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane • Tulsa

983

CARBON BRUSHES
GRAPHITE BRUSHES
BRUSH STOCKS

COMPETITIVE SEALED BID SALE



Take advantage of this great money-saving opportunity. This *unused*, high quality electrical equipment for electrical motors, generators, and other rotating electrical equipment can be easily purchased at a mere fraction of your government's acquisition cost. Large quantities are available in various grades, sizes and shapes. These brushes and brush stocks are offered on competitive sealed bid sale basis by War Assets Administration Regional Offices. Large inventories are held in Cincinnati, Richmond, Chicago, Philadelphia, San Francisco and other Regions. *Act now* to profit in this "fraction-of-cost" sale of Government Owned Surplus Material.

HOW TO BUY:

Valuable materials, such as these brushes and brush stocks, are constantly being offered by all the Regional Offices listed below. Dates of sales—and conditions governing all transactions—will be sent to you upon request. Request should be made directly to Regional Offices.

To keep completely informed on commodities, inventories, minimum and maximum purchases, sales dates, etc., requests should be made to be placed on the mailing lists of each and every Regional Office for the specific types of material or equipment which could serve your needs.

OFFICE OF GENERAL DISPOSAL

WAR ASSETS ADMINISTRATION

GOVERNMENT WAA SURPLUS

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha • Philadelphia Portland, Ore. • Richmond • Salt Lake City • St. Louis • San Antonio • San Francisco • Seattle • Spokane • Tulsa

1024

It's YOUR future—Make the most of it!

Start now to earn the bigger pay in electrical repair

Was there ever such an opportunity to get started in electrical maintenance and repair—and at top-notch wages? Are you ready—with experience and ability—to cash in on it? Others are getting just the sort of background needed—quick! practical!—to handle the great variety of electrical maintenance and repair work TODAY—from this well-known electrical library. You can too!

Electrical Maintenance and Repair Library

5 volumes, 2042 pages, 1721 illustrations

Gives you the "know-how" to tackle any wiring or motor job. Five books show you HOW—to install all types of motor and generator units—to inspect and repair motor starters and generators—to diagnose motor and generator troubles—to figure new windings for old cores, DC and AC windings—to test armature windings, test induction motors, etc., etc. The new book is full of trouble-shooting charts that show quickly symptoms, causes, specific remedies, etc.

Includes trouble-shooting book

Now in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a handy book giving helpful maintenance information, special trouble-shooting charts, explanations of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

10 DAYS' EXAMINATION

Easy monthly payments

We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you decide you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

EXAMINATION COUPON

McGraw-Hill Book Co.,330 W.42 St.,N.Y.18,N.Y.

Send me Electrical Maintenance and Repair Library, 5 volumes for 10 days' examination. If I find the books satisfactory, I will send you $1.50 in 10 days, and $3.00 a month until $16.50 has been paid. Otherwise I will return the books postpaid.

Name .....

Address .....

City and State .....

Company .....

Position EC-3-47

For Canadian price, write Embassy Book Co., 12 Richmond Street E., Toronto 1

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT : "OPPORTUNITIES" : EQUIPMENT
BUSINESS : : USED OR RESALE

UNDISPLAYED —RATES— DISPLAYED

(Not available for equipment advertising)
90¢ a line, minimum 4 lines. To figure advance payment count 6 average words as a line.
Positions Wanted—(full or part time individual salaried employment only), ½ the above rates payable in advance.
Box Numbers—Care of publication New York, Chicago or San Francisco offices count as 10 words.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $8.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.
E.C.

New advertisements received by March 26th appear in April issue, subject to space limitations

FOR SALE

20,000 SQUARE FEET Micarta Sheet, 1/64" to 1" thick, 30% below market value. Any amount you want. Western Plastics, Coos Bay, Ore.

PACIFIC NORTHWEST MANUFACTURERS' REPRESENTATIVE

Want to represent national lines electronic and electric equipment. Excellent contact with industrial trade, jobbers and marine outlets with service organization for lines represented.

INDUSTRIAL ELECTRONICS CO. INC.
1200 N.W. Glisan • Portland 9, Oregon

ELECTRICIANS MOTOR REPAIRMEN

Here is the book that you have been waiting for! A complete, practical encyclopedia of reliable information on all types of Electrical Motors and Controls. Written so that you can understand it. This book contains nearly every type of connecting diagram for Fractional Horsepower, Two Phase, Three Phase and Direct Current Motors. All standard circuits, as well as New special types of Variable Speed, Multi-Speed, Dual-Voltage and Capacitor Motors are included. There are hundreds of selected tables that the electrician needs in his daily work. Methods of rewinding and reconnecting each type of motor for changes in speed, voltage, phase, and frequency are covered in a practical manner. The 1947 edition of 1000 ELECTRIC MOTOR DIAGRAMS AND TABLES is now available. Price $7.25 per copy. Literature upon request. Money-back guarantee.

EDUCATIONAL ADVANCEMENT COMPANY
Dept. CE-1
Lakewood, New York

Prompt ANSWERS to business problems . . .

MISCELLANEOUS business problems are daily being solved quickly and easily by the use of the Searchlight (classified advertising) Section of this and other McGraw-Hill publications.

When you want additional employees, want to buy or sell used or surplus new equipment, want additional products to manufacture, seek additional capital, or have other business wants — advertise them in the Searchlight Section for quick profitable results!

AIR TRANSPORT
AMERICAN MACHINIST
AVIATION
AVIATION NEWS
BUSINESS WEEK
BUS TRANSPORTATION
CHEMICAL ENGINEERING
COAL AGE
CONSTRUCTION METHODS
ELECTRICAL CONSTRUCTION & MAINTENANCE
ELECTRICAL MERCH.
ELECTRICAL WORLD
ELECTRONICS
ENG. & MINING JOUR.
ENG. NEWS-RECORD
E. & M. J. MARKETS
FACTORY MGT. & MAIN.
FOOD INDUSTRIES
POWER
PRODUCT ENGINEERING
TEXTILE WORLD
WELDING ENGINEER

Classified Advertising Division

McGraw-Hill Publishing Co. Inc.
330 West 42nd Street, New York 18, N. Y.

HEADQUARTERS FOR WATTHOUR METERS

WE BUY & SELL
(Prompt Delivery)

ATLANTIC ELECTRIC METER CO.
214 East 41st Street
New York 17, N. Y.

FOR SALE

FISH TAPE, steel, 3/16" x .060, new, excellent, per 100 ft. roll.....$1.95
FUSE, Shawmut, Type M, 10 amp—250 v. ea. ..... .05
FUSETRON, Buss, FRN-15, 15 amp-250v. ea. ..... .10
INSULATORS, porcelain, 2-wire, 1½x1½ ea. .10

GEORGE KOCH SONS, INC.
Evansville 4, Ind.

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SEARCHLIGHT SECTION

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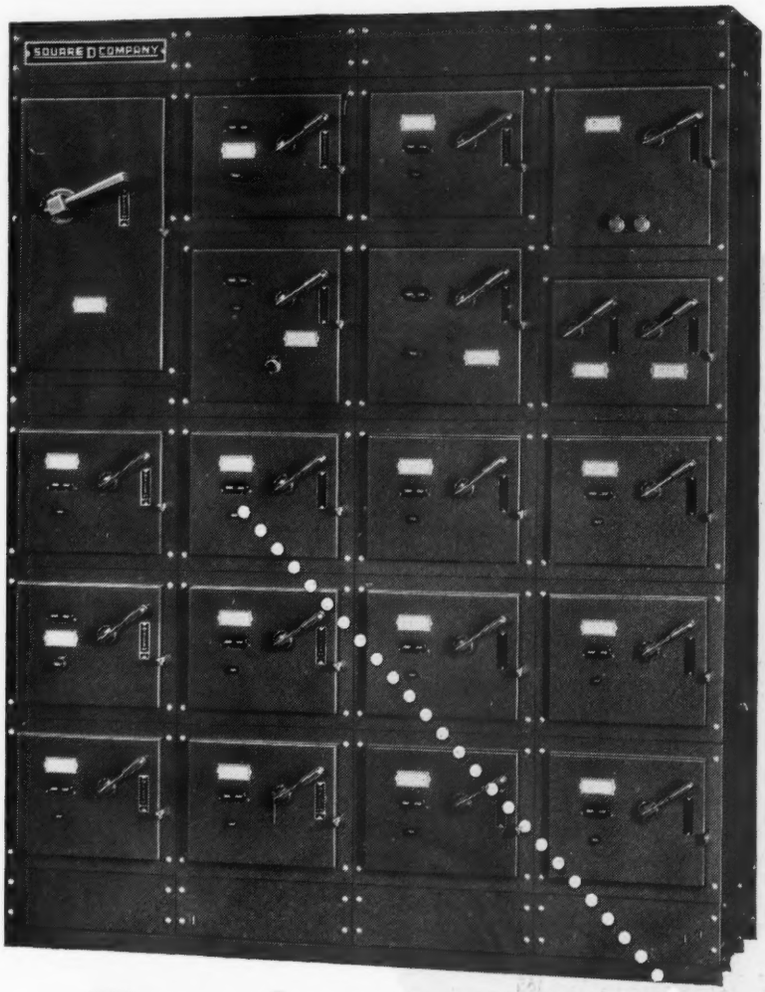
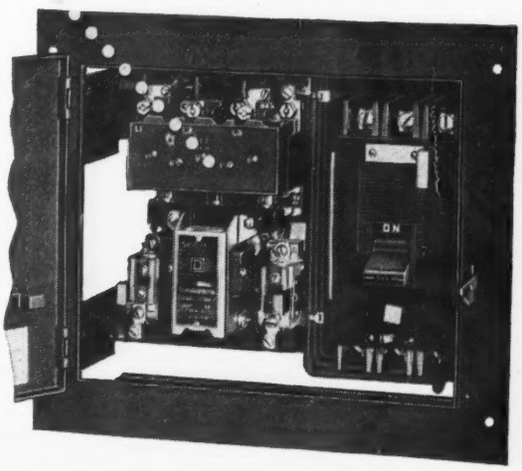
★ These companies have supplied additional buying information on their products in the 1946 edition of the Electrical Buyers' Reference

A PART OF SQUARE D's PARADE OF NEW DESIGNS



Here is a good reason for specifying *Square D* CONTROL CENTERS



• Control centers permit low-cost grouping of starters in favorable locations. They offer the basic advantages of attractive appearance, compactness, easy installation, convenient maintenance and adaptability to future change or expansion.

You get better performance in Square D Control centers because each of the basic advantages is greatly increased by the time-proved design and operation of Square D Starters plus the inherent value of Circuit Breaker protection.

Call your nearby Square D Field Engineer for complete details.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

This switch says plenty by keeping silent

Shhh! Here's silence that's really golden—for you. Quieter than the drop of a pin (you can hear *that*), yet the G-E Silent Switch's very lack of noise is one of the loudest-talking salesmen you can have on the job.

Think a minute. What builds your customers' confidence in you? It's your reputation and the quality of work you do, of course. But did you ever stop to consider how important, too, is the reputation and performance of the wiring you install?

That's where G-E Silent Switches come in, and all the other products in the full line of G-E wiring devices. They are the *visible evidence of quality* on every job. Their name signifies long life and reliable service to every user. Why not install General Electric throughout, and let that big name go to work for you?

WIRING DEVICES by

GENERAL ELECTRIC

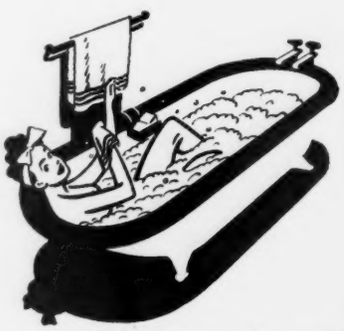
say "G.E." and he'll agree

Wiring Briefs from your G-E Distributors

Are you familiar with the great variety of products in General Electric's full line of wiring devices? Do you know the interesting features that help to make them easy to use and easy to sell? Keep an eye on this column, and you may discover a lot of useful facts and information. We'll keep dishing them out for you.

Now, the entire Watch Dog* line of starters meets a new, high-temperature rating. Maximum recommended operating temperature has been increased from 140 F to 160 F. This is important in installations that are enclosed, or that are subject to high ambient temperatures.

Whether you are already on the profitable fluorescent lighting bandwagon, or just trying to hitch a ride, you need this new folder on "G-E Fluorescent Accessories." It shows you—and your customers—what products G.E. is making, and how you both can use them to advantage. Tells about Watch Dog and standard starters; Slimline, Circline, and Twin Turret Lampholders; and fluorescent starters and switches. Ask us for a supply today.



A certain well-known soap has nothing on those boys in G.E.'s "fuse factory." Do you know that the zinc used in General Electric fuse links has to be *99.98 per cent pure* by laboratory test? Good point to remember when you order the next batch of fuses.

If you want additional information on these, or other G-E Wiring Devices, ask us—your G.E. Merchandise Distributor—or write to Section D50-318, Appliance and Merchandise Dept., General Electric Co., Bridgeport 2, Conn.

**Trade-mark Reg. U.S. Pat. Off.*

Make friends and make money

with famous

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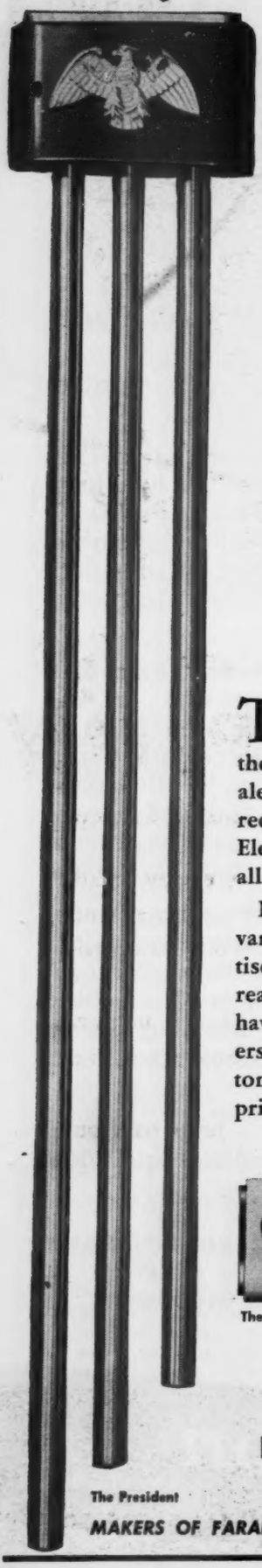
SWEET-TONED

CHIMES



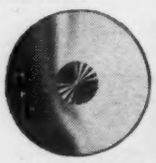
THE ladies have *approved* their styling, tone and quality—and performance has *proved* their positive, trouble-free action. That's why alert, profit-wise contractors everywhere are recommending and installing Faraday Chimes. Eleven beautiful new models offer harmony with all decorating schemes.

Faraday Chimes bring you other valuable advantages, too. They have been nationally advertised in the best-read magazines and thus are readily accepted. And Faraday tubular models have the new exclusive "tone crown" tube hangers (all metal—no strings) which assure richer tones and a minimum of swinging. Fair trade prices, $3.95 up.

Write today for full information!

The Savarin

The St. George



The Madison

The Burgundy

FARADAY

ELECTRIC CORPORATION

ADRIAN, MICHIGAN

The President

MAKERS OF FARADAY BROILMASTER, PLUGMASTER AND SIGNALS

reflectors to subtract enough yellow and orange rays from the incandescent light to provide a white light which more nearly approaches daylight in color quality. It may prove, upon thorough analysis, that other light sources such as flourescent or mercury vapor will produce a better color quality on a more economical basis.

Lighting Layouts. Assuming standard size bays, such as 20 ft. by 20 ft., there are three basic layouts for incandescent lighting systems: (1) symmetrical, (2) staggered, and (3) special, for specific lighting of individual machines or operations. The symmetrical layout is favored for general lighting. Staggered layouts have the disadvantage of leaving unevenly lighted areas along the walls. Special spacing relative to machine operations are usually more efficient in producing higher intensities where wanted, and is satisfactory when machines are permanently located. A system of general illumination should also be provided where special mounting of equipment at machines is used, to prevent undue brightness contrasts.

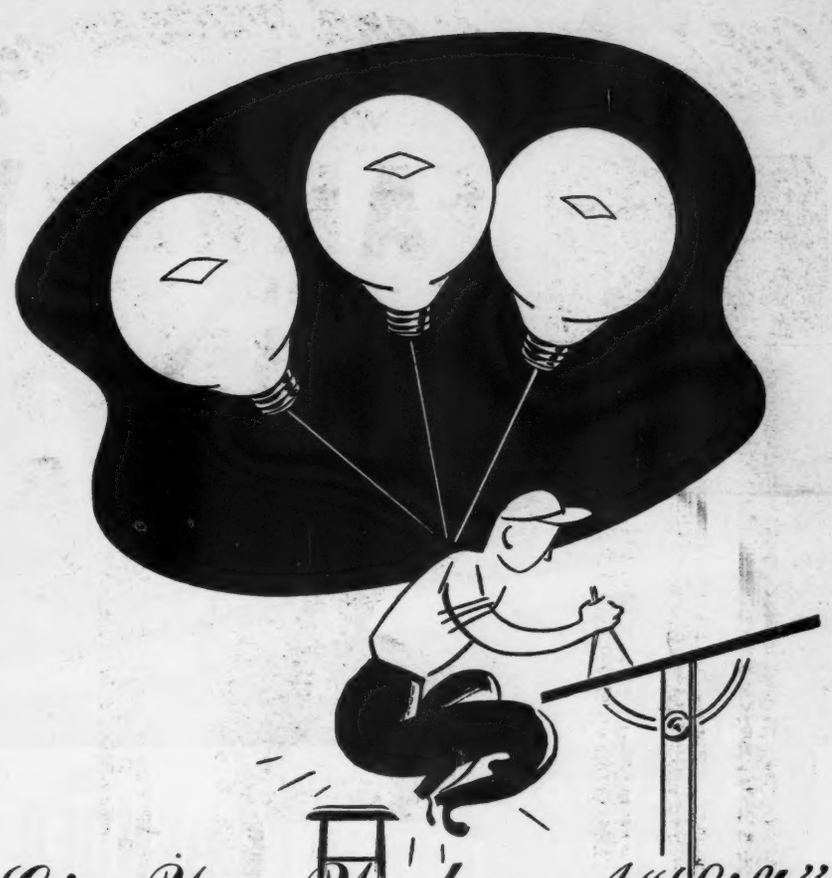
Unequal bay sizes usually require special study. In general, the symmetrical layout will prove most satisfactory. It may be necessary to locate four units in one bay, and two in the next bay, without regard to symmetry of spacing within each bay. Trial and error is used for different size units and different spacing arrangements to arrive at the best solution.

Robert Dodge, associated with the Evans Motor Repair Company of Utica, New York, splices his motor winding with reminiscences of 48 years in the electrical industry. His experiences range from the Oklahoma Territory and Cherokee Strip to winding early model smooth-walled motor slots with coils of solid number 8 wire, tying the coils into place with waxed linen twine.

ROYAL

ROYAL FUSES

ROYAL ELECTRIC CO., Inc.
PAWTUCKET, RHODE ISLAND



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Fluorescent and Incandescent Lamps

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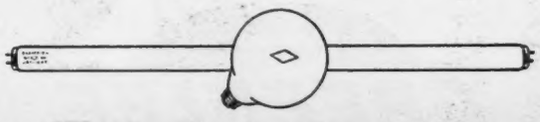
Champion industrial distributors are ready to supply your lamp needs with the utmost efficiency at lowest cost, lighting effectiveness and lamp performance considered.



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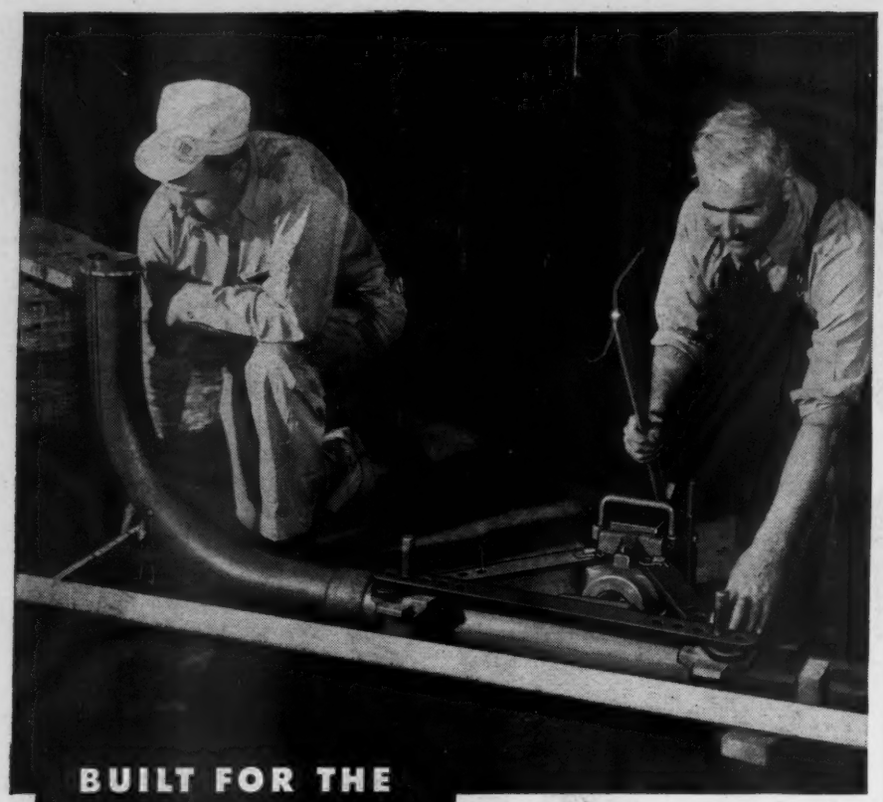

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GREENLEE BENDER

Bending of big 4-inch pipe is taken right in stride by the GREENLEE Hydraulic Bender shown above, on the job for Paul H. Jaehnig, Inc., Electrical Contractors, Newark, New Jersey.

It's one of the 12 GREENLEE Benders owned and regularly used by that company. And, as they report, "It has the strength for tough work . . . does the job very efficiently."

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